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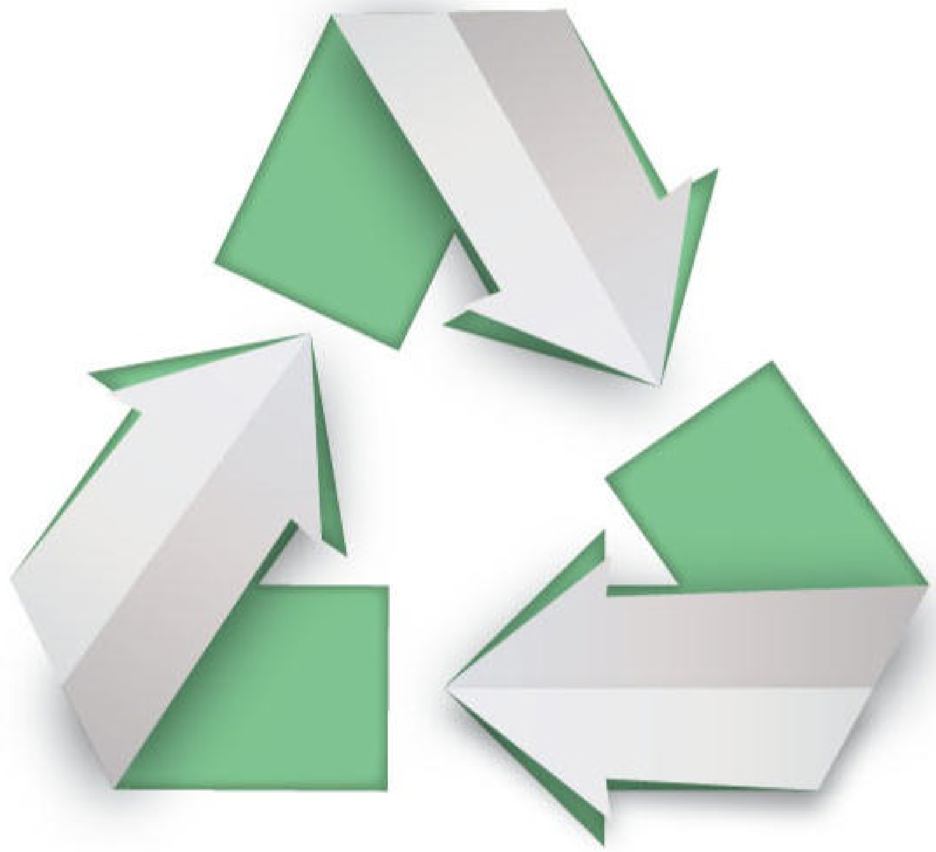

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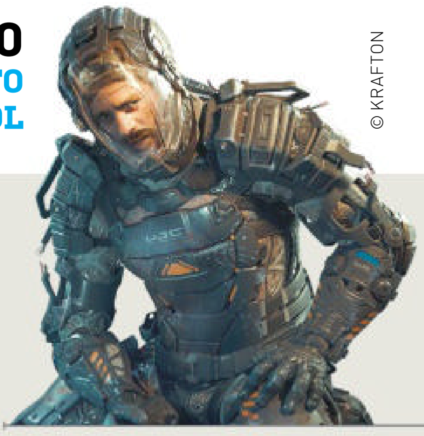

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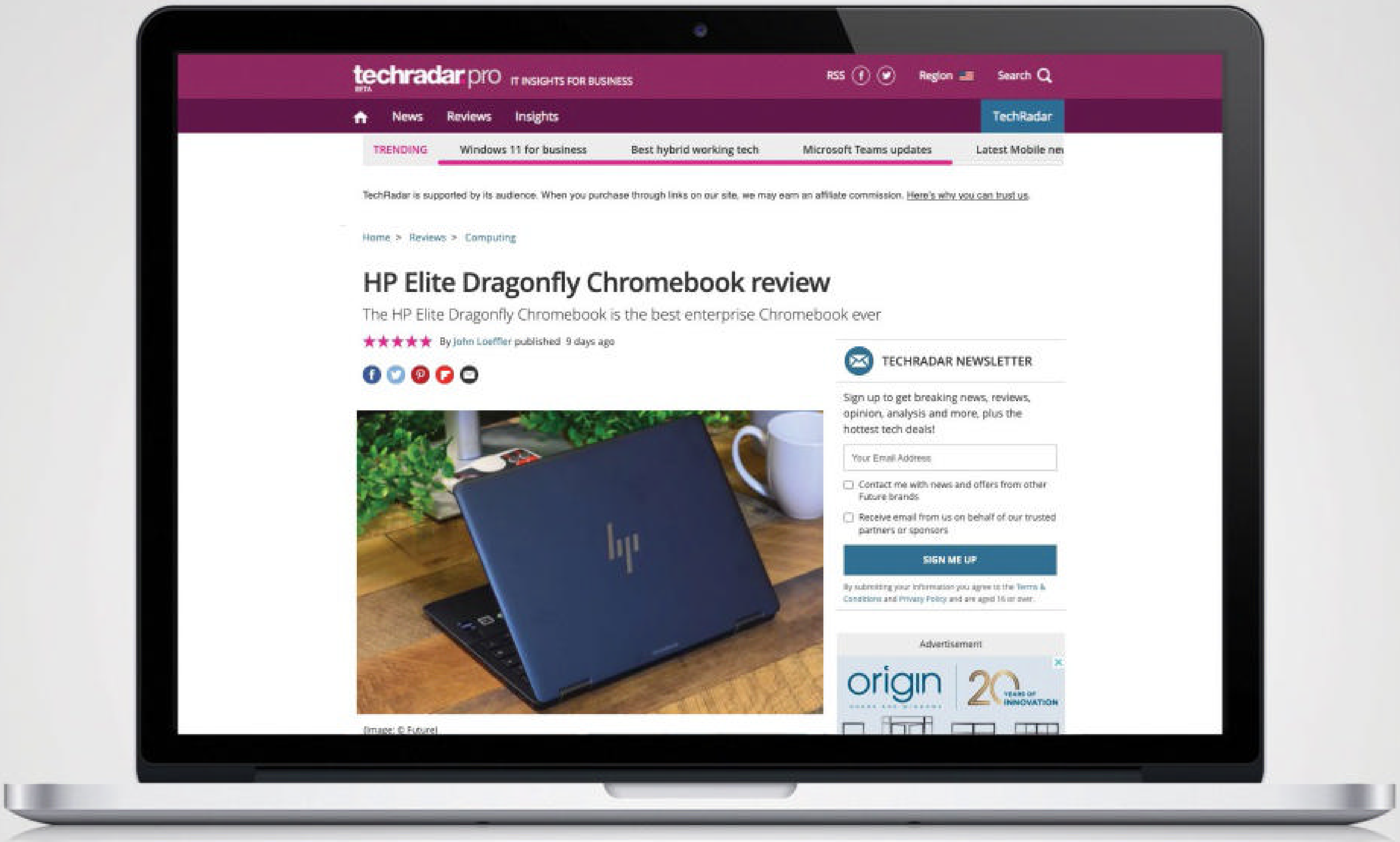
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Staff Writer: Sam Lewis
Contributing Writers: Jeremy Laird, Chris Lloyd, Jarred Walton, Ian Evenden, Nick Peers, Robert Irvine, Louise Blain, Lee Grant
Production Editor: Jon Crampin
Editor Emeritus: Andrew Sanchez

ART
Art Editor: Fraser McDermott
Photography: Neil Godwin, Olly Curtis, Phil Barker
Cover Photo Credits: Future PLC

BUSINESS
US Marketing & Strategic Partnerships: Stacy Gaines, stacy.gaines@futurenet.com
US Chief Revenue Officer: Mike Peralta, mike.peralta@futurenet.com
East Coast Account Director: Brandie Rushing, brandie.rushing@futurenet.com
East Coast Account Director: Michael Plump, michael.plump@futurenet.com
East Coast Account Director: Victoria Sanders, victoria.sanders@futurenet.com
East Coast Account Director: Melissa Planty, melissa.planty@futurenet.com
East Coast Account Director: Elizabeth Fleischman, elizabeth.fleischman@futurenet.com
West Coast Account Director: Austin Park, austin.park@futurenet.com
West Coast Account Director: Jack McAuliffe, jack.mcauliffe@futurenet.com

Director, Client Services: Tracy Lam, tracy.lam@futurenet.com

MANAGEMENT
MD Tech: Paul Newman
Group Editor-in-Chief: Graham Barlow
Group Art Director: Jo Gulliver

PRODUCTION
Head of Production: Mark Constance
Senior Production Manager: Matthew Eglinton
Production Manager: Vivienne Calvert
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Guy
Cocker

MORE NEXT-GEN BUILDING

SINCE THE Nvidia RTX 4090 arrived to a '9 Kick-Ass' award in our December 2022 issue, we've been fixated on the card. I admit to being personally impressed when I did the cover build for the following issue, and after some frustrating boot problems, I was able to see all my favorite games in a new light by playing them at 4K with maxed-out settings. Sam followed that up with a much cheaper 4090 build in the Jan 2023 issue, showing that while the 4090 itself is expensive, it didn't need the latest and greatest CPU, RAM, or motherboard to get the most out of it.

This time it's the turn of the RTX 4080, the much-maligned little sibling of the flagship, which has been somewhat overlooked since its launch at the end of last year. That's understandable—Nvidia somehow managed to make it worse value than the more expensive card, given its price-to-performance ratio. Of course, Nvidia has control of the lever that needs to be pulled to address this imbalance, namely the price. There has already been a price drop in Europe, which may have been reflected worldwide by the time you read this. And with the RTX 4070 Ti, hopefully, price pressures will continue to be exerted on the 4080 to the point where it makes more sense for buyers.

In the here and now, though, our builder Sam has put together *Maximum PC*'s first 4080 build to see what it's capable of outside of the reviews and in the real world. Not only that but he's paired it with the first AMD Zen 4 chip we've featured in a build, in the form of the AMD Ryzen 7 7700X. The resulting build is just under $3,000—similar to Sam's 4090 build from a month earlier. How do the two line up? Check out the feature starting on page 16.

The big reviews keep coming this issue, with both the AMD Radeon RX 7900 XTX and 7900 XT going under the watchful eye of our graphics specialist Jarred Walton. Like Nvidia, there's a feeling from PC gamers that AMD has priced its two top cards in a way that pushes people towards the most expensive offering, but more importantly, are either of them worth buying? Find out on page 74.

Elsewhere this issue, we look at everything you need to get started in podcasting, from the hardware to software, from hosting to distribution. If you've ever wanted to host your own show and reach an audience of millions, we have everything you need on page 32! On a more practical level, we also show you how to save anything to a USB stick, so that you can make the most of those versatile little pen drives that you no doubt have stashed in a desk drawer somewhere. And as rumors swirl of Apple's entry into the VR/AR market this year (see news, page 10), on page 52, we round up the current best headsets available for PC users wanting to enter the metaverse. Or at the very least, play *Half-Life: Alyx* in the best way possible.

On a personal note, this issue marks my 13th as editor, meaning I've spent a year at the helm. Time flies when you're having fun! Thank you to everyone who's read the magazine over the past 12 months, anyone who's written in to say they've enjoyed (or not) our work, and the people listed in the panel opposite who help put it together. 2023 is going to be an exciting time for PC users, so I hope you stick with us for the ride.

Enjoy the issue!

Guy Cocker

Guy is Maximum PC's Editor-in-Chief. He built his first gaming PC in 1997 to play Tomb Raider *on 3dfx, and has been obsessed with all things PC ever since.*

↘ submit your questions to: editor@maximumpc.com

THE NEWS

New GeForce Cards

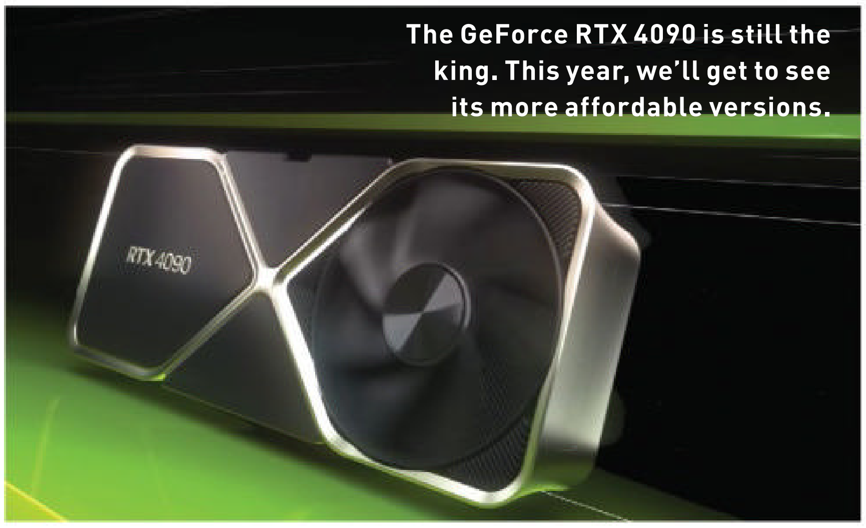
Three new ones have landed, plus a retread

NVIDIA'S GeForce RTX 4090 is a power-hungry giant of a card that sets new performance standards. It's also a buck shy of $1,600 at retail and requires a monster of a rig to give it room to work. The RTX 4080 isn't any smaller, but can't reach the same performance highs, yet still costs $1,199.

What many are waiting for are the more affordable mainstream Ada Lovelace-based cards. These are due to appear this year—the RTX 4060, 4060 Ti, 4070, and the RTX 4070 Ti. The specifications for these have appeared across several sources, although they do not all concur, and none have been confirmed by Nvidia yet, bar the 4070 Ti.

The RTX 4060 and 4060 Ti are based around the AD106 GPU with either 3,840 or 4,352 CUDA cores coupled to 8GB of GDDR6 over a 128-bit 18GT/s bus. Thankfully, the PCB is much shorter, so it will fit into the average rig more easily. Sadly though, the cards also feature the now notorious 16-pin 12VPWR connection. It certainly won't require it, as they are rated at 200W and 250W respectively. We have had no indication of prices yet, but expect them to be at the level of the RTX 3060. The 4060's 8GB of memory is the least you can fit into a proper gaming card these days—we've had 8GB cards at this level for years now, so it's disappointing that the new GPU hasn't got more to play with. The data bus is also on the skinny side, it's half the width of the RTX 3060 Ti's, add in the meager level of CUDA cores—again the old RTX 3060 Ti has it beat—and the performance won't be stunning, even with the extra power the updated GPU brings.

Next up is the RTX 4070, which uses the larger AD104 GPU, and has 5,888 CUDA cores, plus 12GB of memory on a 192-bit, 21GT/s bus. This is a severe cut-down for the GPU, losing nearly a quarter of its cores over the RX 4070 Ti which has 7,680 cores. Power consumption, meanwhile, is 250W. The performance gap between the RTX 4060Ti and RTX 4070 looks to be significant, while the RTX 4070 will go for $600-700 (that is a complete guess, but it probably won't be far off).


The GeForce RTX 4090 is still the king. This year, we'll get to see its more affordable versions.

© NVIDIA

Finally, we have the RTX 4070 Ti, which has a familiar look to it and a familiar specification too. It should do—this card is actually a rebranded RTX 4080 12GB that Nvidia 'unlaunched' not long after unveiling it, due to the amount of backlash it received. The card was viewed as too reduced in power compared to the RTX 4080 16GB to warrant the price as well as the 4080 name. As well as less memory, it sports a different GPU and a narrower memory bus. Now it's back as the unsold ones are re-boxed and re-branded as the RTX 4070 Ti. In its original guise, the card cost $899, and we trust Nvidia will see fit to shave a little off that. The refreshed RTX 4070 Ti is out now, with the other cards spread over the year, with the RTX 4060 not due until the summer.

> Nvidia's cards are overpriced—the pandemic is over, and they now have competition.

Meanwhile, the GeForce RTX 4080 has had a price cut. Only in Europe so far, but it should be global by the time you read this. The card hasn't been a roaring success, as the high price wasn't matched by commensurate performance. If you can afford an RTX 4080, then there's a good chance you can stretch to the much more capable 4090, and it seems that is what people are doing. After the initial burst, sales of the 4080 have been decidedly sluggish, and it has now reached the point where scalpers were struggling to break even (a situation ideal for the word 'schadenfreude'). We predict a $100-150 price adjustment at least. The last thing Nvidia wants is a pile of unsold cards.

Now that AMD has its RDNA 3 cards released, Nvidia is no longer the clear leader for performance, and the Radeon cards are priced keenly. Dedicated gamers will always pay for the best they can possibly afford, but the rest are looking at prices pretty closely, especially during a cost of living increase.

Nvidia's cards look to be overpriced, the pandemic is over, and they have competition. The company would do well to cut prices across the board. **–CL**

intel
ARC
GRAPHICS

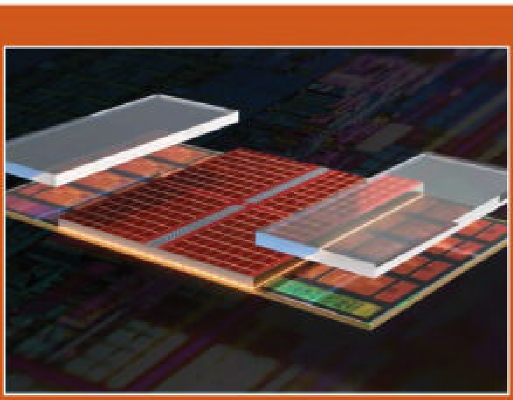
GIGABYTE EMBRACES ARC

ANOTHER GRAPHICS PARTNER FOR INTEL OFFERS SUPPORT

INTEL'S ARC GRAPHICS card hasn't made much of a splash, with AMD and Nvidia owning top-level gaming. However, mid-range cards are where the majority of sales are made and, here, Arc Alchemy cards are making an appearance. Most cards we've seen are Intel-branded, but Gigabyte has now joined the party, selling low-end branded Arc cards in selected markets, with presumably the A750 and A770 cards to follow. One weakness of the Alchemist cards has been the underdeveloped and buggy driver, but the latest version addresses the terrible performance under DirectX 9. The driver now has native DirectX 9 support, although only for selected games (currently 13 titles). It can give a dramatic boost too, with a frame rate that doubles in some cases. Arc has been slow to market, but Intel has kept one promise it made—it is a cost-effective option. **–CL**

THE RETURN OF V-CACHE

Ryzen set to reclaim gaming CPU crown



THE LAUNCH of AMD's Zen 4 Ryzens had one thing missing: there were no 3D V-Cache chips with that wad of L3 cache laid over the cores. The previous generation's eight-core Ryzen 7 5800X3D had 96MB of L3, making it a gaming demon. AMD said it would return to the formula, but now rumor has it that we'll see three new V-Cache Zen 4 chips this year, with either 16, 12, or 8-cores. The larger two chips have 192MB of L3, while the smallest has 96MB. Eight cores are ample for gaming, which is one reason AMD stuck to that on its original V-Cache chip. Content creation is another matter, though. The Zen 3 V-Cache chip was not overclockable, and ran slower (200MHz) than the stock Ryzen 7 5800X, mainly so it didn't run too hot. These new versions are expected to run closer to stock speeds and to be more open to tweaking. They should put AMD back on top with the fastest gaming chips in town. **–CL**

Tech Triumphs and Tragedies

A monthly snapshot of what's good and bad in tech

TRIUMPHS

✓ **CHIP IN YOUR HEAD?**
Neuralink is months away from human trials of an implanted brain-computer interface.

✓ **APPLE OPENS-UP SHOP**
It saw off *Fortnite*, but now Apple is preparing to allow third-party apps on iOS, breaking the monopoly of its own App Store.

✓ **BIG NEW FAB**
TSMC is to build a $40 billion second fab at its Arizona site. It will produce 3nm chips and be operational from 2026.

TRAGEDIES

✗ **HACKER BEACHES FBI**
After discovering a loophole in an FBI database, someone put details of 87,000 'high-profile' people for sale on the dark web.

✗ **KILLER ROBOTS**
San Francisco authorities have approved deployment of police robots capable of lethal force.

✗ **UNSAFE PASSWORDS**
The password manager LastPass has been compromised again, the seventh such scare since 2011.

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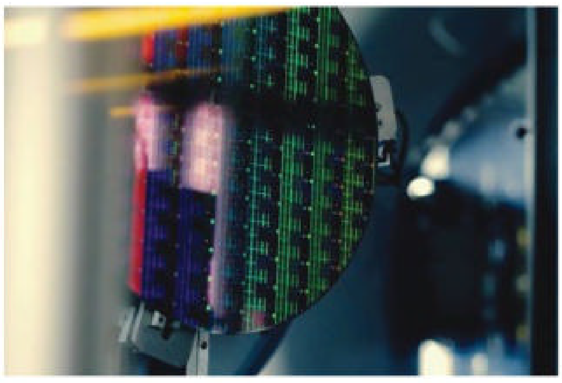


RAPTOR LAKE GETS A REFRESH

Intel to get one iteration in before Meteor Lake

INTEL'S development is running at some pace, although Meteor Lake appears to have hit a snag, so Raptor Lake will be refreshed this year instead. New slides leaked from Intel show this is scheduled for this fall, almost exactly a year after the launch. Originally, the LGA 1700 socket was designed to run two iterations of processor but now gets a third. The range is to get a rework, but it's not clear whether we'll get more than fiddling with clock rates and boost configurations. They will use the same motherboard chipset—no news on a 34-core Raptor Lake glimpsed at Intel Innovation last year, however. We will also be treated to non-K versions of Raptor Lake, the mainstream 65W parts without the high boost clocks. These replace the 12th-gen Alder Lake chips and offer 5-10 percent more horsepower. So far, we've seen a Core i9-13900, i7-13700, i5-13600, 13500, and 13500.

Another slide shows a return to the Workstation market, replacing the Cascade Rapids chip (14nm processor based on Skylake) with Sapphire Rapids-64L and 112L chips, cut-down Sapphire Rapids-WS, with the numbers referring to the PCIe lanes on each chip. No news of returning to the HEDT sector proper, as Intel currently only lists four HEDT chips, all 10th-generation ones. There is a Raptor Lake category labeled 'Entry Workstation', using the W680 chipset. Could this be where we see that 34-core Raptor Lake?

Intel claims it is on track to have the Intel 4 process reach volume production before the end of the year, with Intel 3 doing the same next year. After that, we have Intel 20A and 18A, currently scheduled for 2024, at which point Intel should be back at the cutting edge of processor nodes. Despite the slight stutter, Intel appears determined to catch up with its rivals. **–CL**

LG'S CURVED BEAUTY

240Hz of gaming perfection

LG HAS a range of monitors called UltraGear, aimed directly at gamers, and it has announced a new flagship model, the 45-inch 45GR95QE. Big, and now, for the first time, curved with an 800mm radius, so your head won't be far away from the action, it features the world's first 240Hz OLED panel, exclusive to LG. This has a resolution of 3,440x1,440, a fast response of 0.03ms, and a contrast ratio of 1,500,000:1, thanks to the OLED panel, meaning you get proper blacks. There's an anti-glare coating to limit any annoying reflections. Connection is via Display Port 1.4, and a pair of HDMI 2.1 ports. There's also a USB 3.0 hub and a headphone jack. It has a typical DCI-P3 of 98.5 percent (the color space), so you'll get a rich range of colors ideal for HDR content.

It's a good-looking panel too, beautifully slim with a svelte surround and not a distracting logo on view. Apart from the size, LG is making the most noise about the refresh rate, which coupled with a near-instantaneous response rate, means minimal lag, smears, and ghosting. If you're running a high-end graphics card you need a monitor that keeps pace, otherwise, those extra frames generated are pointless.

This highly-anticipated beauty was announced a few months ago. However, at 45-inches and a resolution of 2K, it means the pixel density is on the low side, which you'll notice if you're used to a smaller screen at the same resolution. There's a smaller sibling too, the 27-inch model featuring a similar 240Hz OLED panel—this one is flat, and has a resolution of 2,560x1,440. The 27GR95QE costs $999, and the 45GR95QE will set you back $1,699. Yes, that's a lot, but high-end cards deserve high-end screens. **–CL**

Radeon's RDNA 3 isn't Broken

NOT LONG AFTER AMD's RDNA 3 GPUs landed inside 7000-series cards, there were reports that the shader pre-fetch on some versions didn't work. Cue accusations that AMD shipped unfinished cards. AMD said that RDNA 3 fully supports shader pre-fetching and claims that the errant code is for an experimental function that was not "targeted for inclusion in these products". Including hidden features on a chip is common practice, but that doesn't explain how this mistake ended up out in the wild.

Meanwhile, others have found their early cards have a fluctuating base clock, with one tester seeing speeds range from 2.4GHz to 2.9GHz, playing havoc with benchmarks. Some speculate that flawed A0 silicon is to blame and that design goals were not met. Getting a new architecture right the first time is no easy task, just ask Intel, which has shipped chips with multiple documented 'errata'. Expectations for RDNA 3 were unrealistically high, the launch was rushed, and whatever the underlying issues are, AMD would do well to come clean if it's something we should know about. On average, the card is 35 percent faster than the previous generation, and it's better value than the new GeForce cards, although there's clearly room for improvement, particularly in the driver. A good GPU; but a poor start. **–CL**

AMD's RDNA 3 silicon is fast, but not as fast as the rumor mill predicted, which annoyed some.

AI Programmer

The common trope for AI is that the machines will take over, and there are plenty of tasks where AI does a better job than a human. Google's DeepMind division has proved this by making AI-powered gaming systems that can beat almost everyone easily. Now, they've built an AI-powered programmer that can complete programming challenges. The system has been trained on 700GB of commented code from GitHub.

The AI treats a programming challenge as a description of a task, then creates functional code based on working code it 'knows' thanks to its training. The AI produces many potential answers, about one percent of which are practical solutions that can be concentrated on. It can complete a third of programming challenges, about average for a human coder. So coders aren't out of a job just yet. But given time, it will only get better. **–CL**

Apple's xrOS

Virtual reality in its various forms has been the next big thing for so long now, it's become a standing joke. Despite Meta's floundering metaverse, Apple is set to join the party and is going to do it in its own unique way. There's a dedicated operating system, called xrOS, which has been in development for five years under the name RealityOS.

The 'xr' stands for extended reality, covering both augmented and virtual applications. As well as gaming, the focus will be making virtual meetings more immersive and 'all-encompassing'. We'll get xrOS versions of major Apple apps, including Maps, Messages, and FaceTime. Later this year, we'll see new Apple mixed-reality headsets, expected to be similar to Microsoft's HoloLens. Apple's system will almost inevitably be expensive, but can it buck the AR/VR trend and actually be useful and popular? **–CL**

© LG, AMD

Jarred Walton

TECH TALK

Nvidia RTX 4070 Ti Incoming

WHEN NVIDIA OFFICIALLY announced its Ada Lovelace architecture, it revealed plans for three graphics cards: RTX 4090 as the king of the hill at $1,599; RTX 4080 16GB as the step-down prince for $1,199; and the RTX 4080 12GB at $899. To say people weren't pleased with the pricing and specs would be an understatement. Nvidia "unlaunched" the 4080 12GB, stating that "having two GPUs with the 4080 designation is confusing."

To be clear, we weren't offended by the name so much as other aspects of the card. The problem was in the specifications and potential performance, as well as the large jump in generational pricing. Nvidia's own numbers show the 4080 16GB delivering 30 percent higher performance than the 12GB variant. That's not a minor difference in performance; it's a gaping chasm.

Let's put things in perspective. By our own figures, the RTX 3080 12GB outperforms the original RTX 3080 10GB model by just 10 percent on average at 4K ultra—less at lower settings and resolutions. A 30 percent gap is what we're used to seeing between different GPU families, like the 3080 Ti versus the 3070 Ti, where there's a 30–45 percent gap. By that token, renaming the 4080 12GB as the 4070 Ti solves part of the problem.

What we don't know yet is how much Nvidia plans to charge for the 4070 Ti. The 4090 launched at $100 more than the 3090, but the 4080 matches the 3080 Ti MSRP and sits $500 above the 3080. We'd like to think Nvidia will be sensible and launch the 4070 Ti at the same price ($599) as the outgoing 3070 Ti, but that's probably misplaced hope. Even $699 would feel quite onerous for a formerly midrange model number, and Nvidia might even go higher than that—people will be rightly outraged if Nvidia sticks to the original 4080 12GB price of $899.

> "By renaming the 4080 12GB as the 4070 Ti, Nvidia has only solved part of the problem.

We'll find out next month exactly where the 4070 Ti lands, in price as well as performance. Nvidia has been pushing DLSS 3 performance data for the 40-series, but the more we play with it, the less enamored we become. Artifacting is only part of the problem; Frame Generation on its own simply doesn't make a game feel more responsive and can actually make things worse.

Portal RTX is the perfect example of this. At native 4K, even the mighty RTX 4090 only manages an unplayable 20fps. Turning on DLSS 3's Frame Generation bumps that up to 37fps, but the input still feels like 20fps (because it is). It's not that Frame Generation makes no difference at all, but it's mostly about smoothing out visuals at already reasonable framerates.

The RTX 4080 at 4K with DLSS Performance mode runs at 42fps, which is playable but not smooth. With Frame Generation, it gets 70fps. The input from your keyboard and mouse is still running at 42fps, but the screen updates more frequently and looks smoother, which I suppose ultimately feels a bit smoother. Just don't expect Frame Generation to feel great if you're not already getting well above 30fps.

Nvidia's maligned RTX 4080 12GB was axed, only to be rechristened as the RTX 4070 Ti: same specs, but hopefully less expensive.

One parting shot for Nvidia is that the melting 16-pin adapter issue has apparently been 'solved'. Nvidia released an official statement, over a month after the launch, saying, "Our findings suggest a common issue is that connectors are not fully plugged into the graphics card. Nvidia is committed to ensuring an expedited RMA process, regardless of cable or card used."

There were at least 50 reported cases of melting adapters, and it's possible that the extra four sense pins on the 16-pin connector made it more difficult to fully connect the cable, resulting in this problem. Certainly, we didn't hear about any 30-series cards with 12-pin or 16-pin adapters melting. The bottom line is, make sure that you plug your extremely expensive graphics card in properly.

Jarred Walton has been a PC and gaming enthusiast for over 30 years.

© NVIDIA

THE LIST

THE TOP FIVE USB WI-FI ADAPTERS

WHILE IT'S TRUE that most laptops and desktops these days come with Wi-Fi on board, there are still plenty of budget motherboards that don't. There are also many instances where your home network becomes more technologically advanced than that available from your devices, meaning you can't take advantage of the increased speed and range. Or some of you might have finally set up that home office in a shed at the end of the garden. Whatever the reason, we've listed five of the best ways to add Wi-Fi to your setup through the good old medium of USB.

5 LINKSYS WUSB6300

www.linksys.com
$37 This is the adapter to go for if size is key, as this thing is absolutely tiny—even Linksys itself calls it 'micro'. It's nowhere near the fastest at AC1200 speeds, but 860Mbps via a 5GHz channel should be speedy enough for most users. MU-MIMO and Beamforming support also means that range won't be an issue and you can stretch even further away from your router with this than with many other more expensive adaptors.

4 EDIMAX EW-7833UAC

www.edimax.com $42
A step up from the Linksys in terms of physical size and speed is the EW-7833UAC. It supports the newer AC1750 standard, which will boost speeds across both 5GHz and 2.4GHz bands. Besides, if it's pure speed you're after, then Edimax's stick smokes the competition—the only downside is that it doesn't have the best long-range wireless performance, so isn't the one to buy if you're after a Wi-Fi connection for the end of the garden.

AC1750
EDIMAX Gemini

3 ASUS USB-AC68

www.asus.com $90
As you can tell from those two cute little antennae, this is where our wireless dongles start to get serious. This stick supports USB 3.0 for faster transfers, the AC1900 standard for even more bandwidth, and all the Beamforming and MU-MIMO features you'd expect at this price. However, somehow, it's not the fastest on either 5GHz or 2.4GHz channels, hence it being in our number three position.

2 NETGEAR NIGHTHAWK AC1900

www.netgear.com $67
This is the wireless dongle for gamers. It comes with a magnetic cradle so you can stick it on top of your gaming desktop for (hopefully) a better signal. As the name suggests, this is a blazing-fast AC1900 connection and performed brilliantly in terms of speed and range in our tests. We wouldn't use it in a laptop, however, as we'd frankly be scared of snapping it off given its relatively large size.

1 TRENDNET TEW-809UB

www.trendnet.com $70
One glance is enough to confirm this is the professional choice for USB Wi-Fi adaptors—just look at this thing! It's clearly not meant for portability, instead offering four positionable antennae each with a strength of 5dBi each. This means it's best suited for situations where the Wi-Fi signal is weak—surprisingly it's not the fastest receiver we've used and doesn't support MU-MIMO either.

© LINKSYS, EDIMAX, ASUS, NETGEAR, TRENDNET

Jeremy Laird

TRADE CHAT

This cannot go on. It will not go on

IT'S NOT EVEN NEWS to point out that PC graphics card pricing is ridiculous. And yet to merely complain about over-priced graphics boards fails to capture the disconnected, unhinged state of the GPU market. The way AMD and Nvidia priced their new cards makes no sense. It cannot go on.

How we got here is well documented. It was a perfect storm of spiraling crypto-fueled demand, multiple Covid-induced market shocks and distortions including supply chain disruption, stay-at-home induced consumer behavior, and a new generation of GPUs that delivered a big boost in performance after several years of relative stagnation. That explains why Nvidia's GeForce RTX 30 Series and AMD's Radeon RX 6000 went through the roof following their launch in late 2020.

It all made sense, even if didn't make paying three to four times the RRP for a graphics card any more fun. But here we are at the end of 2022, crypto has crashed, the influence of the pandemic is shrinking and the latest new generation of GPUs is a mixed bag. Yet both AMD and Nvidia are pricing their new cards as if 2021 is the new normal. Well, it's not. The obvious exception is inflation, currently blighting pretty much every major economy. But inflation nowhere near justifies Nvidia's attempt to price the new RTX 4080 at $1,199, a ludicrous 70 percent price hike over the RTX 3080.

Of course, it took two years for any 3080s to actually hit their $699 official MSRP. That literally only happened in the last month or so. But, once again, there were clear reasons for that. Moreover, by the time you read this, Nvidia will probably have launched either the RTX 4070, the RTX 4070 Ti, or possibly both. Almost certainly you'll be looking at a price of no less than $700. And that is for a third- or fourth-tier GPU.

> Nvidia and AMD aren't just ripping off gamers, they're hurting their own businesses.

When it comes to pricing, AMD's new graphics cards are just as bad as Nvidia's.

AMD's new cards are no better. The Radeon RX 7900 XT and 7900 XTX at $899 and $999 would have been priced even higher had they offered more competitive performance. Along with Nvidia's new-gen cards so far, they simply beg the question of what the mainstream PC gamer is supposed to buy. AMD and Nvidia seem to have forgotten that PC gaming is a mass market pursuit.

Graphics cards aren't, say, boutique supercars that can be made in their handfuls and bought by a few ultra-wealthy clients. PC gaming as an industry depends on accessibility. The only reason it makes sense for game developers to invest huge sums in developing modern titles is the potential market of millions of gamers with compatible hardware. But in terms of both pricing and reports of relatively low production for these new GPUs, the philosophy seems to be low volumes at much higher prices and margins.

Because millions of PC gamers can't afford $700 for a new graphics card, let alone $1,500 or more. That's never been the case in the past and it hasn't become the case now. Only the laziest observer would conclude that was even the case at the height of the crypto-Covid GPU craze, ignoring the highly unusual combination of an acute shortage of GPUs combined with a higher-than-usual demand.

Put simply, there is no way that PC gaming as a mass pursuit can thrive in an era of $700 mid-market GPUs. Prices are, therefore, going to come down. The only question is exactly how long it takes and how much damage is done to PC gaming in the interim.

It's an incredibly short-sighted way to go about things from Nvidia and AMD. They're not just ripping off gamers, they're hurting their own businesses. The longer they stick at this nonsense, the smaller the remaining market of PC gamers is going to be when they come back to their senses.

Six raw 4K panels for breakfast, laced with extract of x86... Jeremy Laird eats and breathes PC technology.

© AMD

DOCTOR

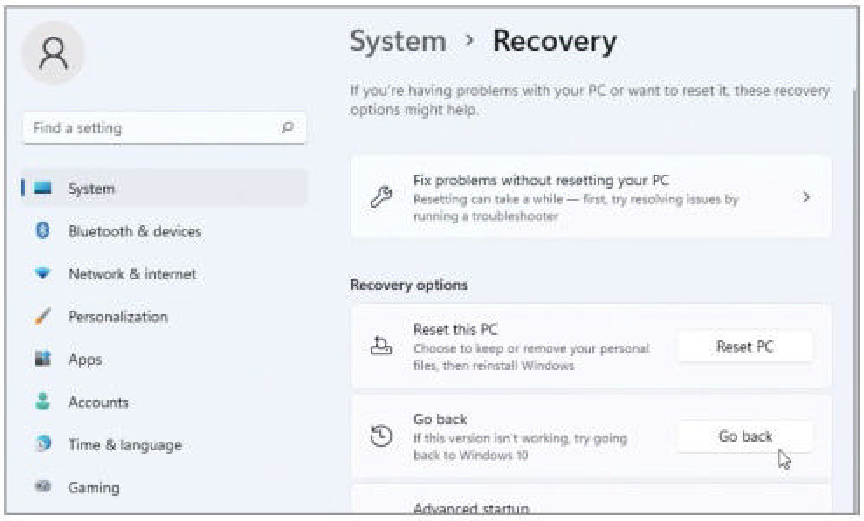
THIS MONTH THE DOCTOR TACKLES...

> Wireless Bands
> OneDrive Storage
> Win11 downgrade?

Megahertz Madness

I was recently exploring my router's settings—more through curiosity than any particular need. While there, I found an option to adjust channel widths. It was preset to 20/40/80MHz, but there was a tick box to enable 160MHz. What does this mean and what's the difference between them? Bigger usually means better, so should I enable the 160MHz option?

—James McCarthy



System › Recovery

If you're having problems with your PC or want to reset it, these recovery options might help.

Fix problems without resetting your PC
Resetting can take a while — first, try resolving issues by running a troubleshooter

Recovery options

Reset this PC
Choose to keep or remove your personal files, then reinstall Windows

Go back
If this version isn't working, try going back to Windows 10

Advanced startup

You can always roll back to Windows 10 from Win11, once installed. But be quick, as you've only got ten days to do it.

© MICROSOFT

THE DOCTOR RESPONDS: It can, but this is a complex area where sometimes less is more. By necessity, we're going to have to simplify matters. Though not a perfect analogy, think of Wi-Fi bands such as 2.4GHz and 5GHz as freeways. In this context, the channels are lanes. Each lane can carry only so much data—or vehicles, to stretch our analogy. A standard channel on either band has a lane 'width' of 20MHz, enough for narrow vehicles only.

Here, our analogy breaks down a little, but to send more data, more efficiently, wider vehicles are needed and that means wider lanes (channels). Modern Wi-Fi kit allows the use of 'bonded' channels, so two 20MHz channels can become one with a 40MHz width, while four provide an 80MHz lane.

Modern routers, such as the TP-Link Archer AX55 (around $100), support bonding of up to eight channels, for a 160MHz lane width. In theory, that would allow the router to transfer data to compatible devices much faster than is possible with 'narrower' channels.

That sounds good, but there is interference to consider. Just as a wide vehicle can interfere with other road traffic, so too does an expansive Wi-Fi channel restrict space available for data that's unable to travel that route. Not all devices are compatible with 160MHz lanes, so enabling this option may result in better performance for some devices but worse for others.

For most people, this stuff is best left to the router and devices. However, don't be afraid to enable the option. You can always switch it off if any of your connections are adversely affected.

OneDrive Half Full or Half Empty?

Microsoft's constant prodding to get me to back up my data to OneDrive has obviously worked, as I now make sure all of my data is saved on its cloud. However, I recently received an email telling me that my OneDrive was almost full. I've been creating some large files for our local magazine lately, so how do I check how much space I am 'allowed', and how much I've used on OneDrive? **— John Howell**

THE DOCTOR RESPONDS: This is one of those obvious-when-you-know-how kind of problems, so The Doctor is happy to help.

Unless you're paying Microsoft for extra storage (via a Microsoft 365 subscription), then the standard OneDrive allocation is 5GB. To check what you have, right-click the OneDrive icon in the notification area on the right side of the Windows taskbar, then click the cog icon, followed by Settings. Now click to select the Account tab and you'll see your current tally and allocation.

For more detail, or to upgrade your storage quota, click the 'Manage storage' link. You'll be directed to the web version of OneDrive, where you can see what's what. To see options for more storage, click the 'Plans and upgrades' link on the left.

↘ submit your questions to: doctor@maximumpc.com

Microsoft can be annoying with its constant reminders to use OneDrive, but its storage plans are pretty competitive, especially if you have family or friends with whom you can share the Microsoft 365 Family plan. And if you're a heavy Windows user, the seamless syncing of files across devices is pretty neat, too.

We're also fairly sure that, in a Windows 12 future, Microsoft would allow people to jump straight from 10 to 12—just as Windows 8/8.1 users can jump to Windows 10 (and then to 11, hardware compatibility permitting).

Windows 11 Plan B

I've been reading in your fine publication that Windows 11 take-up has been rather slow and, I'm afraid to say, I'm one of the people contributing to this. I'm ready to take the plunge now that it's more stable and compatible, but I want to make sure that if I upgrade from Windows 10 to 11, can I go back to 10 if I don't like it? Also, if I can make the choice to go back, will I still be able to upgrade to Windows 11 later on, or Windows 12 if that's what Microsoft releases next?

— Bernie Weatherford

THE DOCTOR RESPONDS: We can understand the trepidation about upgrading, especially for professionals where stability is key. Bear in mind that while you can downgrade to Windows 10, Microsoft makes that option available for 10 days only. Beyond that time frame, the only way to go back to Windows 10 is by wiping Windows 11 and performing a 'clean' install.

Within the 10-day period, click the Start button followed by the Settings cog, and then System followed by Recovery. Under 'Recovery options' click 'Go back' and then follow the prompts.

No one can say with any certainty if or when Microsoft will turn off the free upgrade option, or whether that offer will be available from Windows 10 to 12, if it arrives. However, based on past behavior, we're confident you'll be able to upgrade from Windows 10 for a long while yet.

Getting out of a time loop

I have a nine-year-old Alienware M14 laptop that I cannot bring myself to replace. Every time it's switched on, I have to manually set the date and time via the time.windows.com server.

There are no beeps to signify a fault and the laptop otherwise works fine. I suspect a failed CMOS battery, but this laptop requires significant disassembly to get at it. However, given the lack of beeps or errors, I wonder if there could be something else that's causing this.

—Em Archer

THE DOCTOR RESPONDS: You're right that this problem is symptomatic of a CMOS battery that's run out of power—and after the best part of a decade, that's likely to be the case. So why aren't you getting broader, BIOS-related error messages?

Well, that's because while some laptops use a CMOS battery to ensure BIOS settings are saved, just like a desktop PC, more advanced models store these essentials in a special area of 'non-volatile' flash memory—the sort that doesn't forget its contents when the power is removed. That leaves the CMOS battery responsible only for powering the machine's real-time clock (RTC) function, as no powered-down computer can keep time without it.

So, that's the explanation. The fix, as you know, is to strip down the machine to get to the battery, or just put up with resetting the clock after each power down. It's annoying, but sadly the only options available without calling it a day for the Alienware and upgrading your laptop.

Linux and Windows in harmony

I've been toying around with Linux on a Raspberry Pi, and I've enjoyed it so much I'd like to occasionally run a Linux operating system on my PC. I don't want to do this from a live disk, but I also don't want to use any of my limited NVMe boot drive's space either. What's the simplest solution? **—Peter Fairfax**

THE DOCTOR RESPONDS: Thanks to the great leap forward brought by USB 3.0, you can run Linux (or indeed Windows) from an external SSD. USB 3.0 transfers data at 5Gbps, which means any external SSD will do.

However, if you have USB 3.1 ports, you can double this speed—just make sure you pick a drive capable of delivering up to 10Gbps, such as Samsung's T7 ($95 for 1TB).

Taking Ubuntu (https://ubuntu.com) as a good example of Linux to install, the key thing is to choose 'Something else' under Installation type when installing. This is the most vital requirement—make sure you correctly identify your drive by size and used space (it definitely won't be 'dev/sda', which is your Windows drive).

Once identified, select the current NTFS or FAT32 partition and click the '–' (dash) button to remove it, then click '+' (plus) to create an ext4 journaling partition in its place. Now select this newly created partition and let the installer continue.

Once finished, whenever you want to boot to Linux, simply override your default boot drive at startup (typically press F11 to bring up the boot menu) and instead choose your external SSD to boot from. After that, you should be able to get cracking and have some open-source fun!

Dreaming of Dual Booting

I'm trying to dual-boot Windows 10 and 11 on the same NVMe drive, which has 700GB free from a total of 1TB. I've tried shrinking the Windows 10 system drive to free up 500GB of space using Disk Management in Windows, but it's adamant it can only free up to 100GB. That won't be enough for my Windows 11 needs. Any ideas as to what should I do?

—James Pelton

THE DOCTOR RESPONDS: The reason Disk Management can't give you access to all the available space on the drive is that it doesn't reboot Windows during the partitioning process. As a result, it's unable to handle unmovable files such as page files, which often sit near the end of the volume, keeping them out of the way of other file operations to prevent disks from fragmenting. Windows judges available free space from where this last file ends.

You may get lucky and find that after a couple of reboots, Windows rearranges the files in such a way as to allow the drive to be shrunk, but a quicker and easier option is to use a third-party partitioning tool, which reboots during the resizing process to bypass the issue of where files are stored on the drive. The reboot allows the files to be removed or rearranged as required to free up to 100 percent of the reported available space.

One such tool is Paragon Partition Manager Community Edition, which is free for personal use. On our test PC (a 230GB drive with 35GB free space), Paragon was able to shrink the partition by the full amount after Windows' Disk Management tool claimed that only 2.4GB could be freed up.

RTX 4080 GAMING MACHINE

An AMD Ryzen 7 7700X and Nvidia GeForce RTX 4080 Founders Edition walk into a bar... Unfortunately for our builder, *Sam Lewis*, things didn't get off to a great start

WE DIDN'T HAVE the easiest time with this machine, but that's nothing to ward you away from using either the RTX 4080 or one of the latest AM5 chips. PC building isn't always fun and games.

We'd been looking forward to testing the founder's edition RTX 4080 in a machine, especially since Nvidia unreleased the initial 12GB model. Although we didn't rate it as highly as the RTX 4090, there's no denying you'll get a great gaming experience from it.

Our humble CPU got a warmer reception when we reviewed that, so we were as excited to add this into its first build as we were with our GPU. This AMD Ryzen 7 7700X boasts great eco-performance and impressive bang for your buck. As it sits in the middle of the new AM5 releases, it tends to get overlooked but we can't wait to get it in the hot seat for this machine.

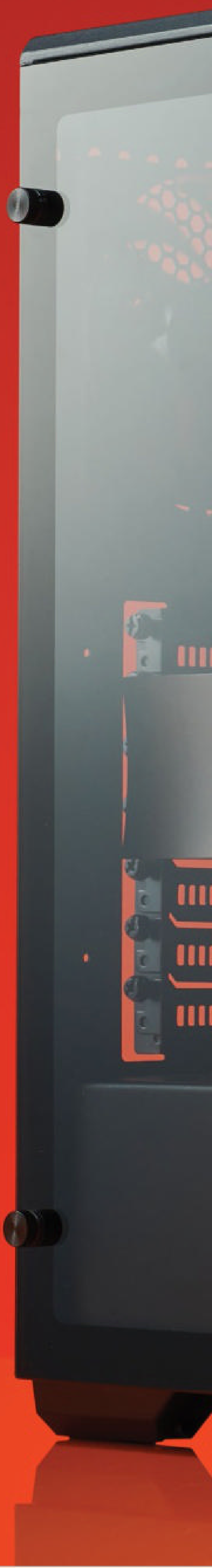
What is that seat, you may ask? Well, it's a darn good one, the Asus ROG Strix B650-A Gaming WIFI. A fully-fledged motherboard with an abundance of features and futureproofing capabilities to get the best out of our CPU/GPU combo. We always try to keep future-proofing a key part of building a PC. Especially when we're using expensive components, you want them to perform at their best with plenty of longevity too.

DDR5 is a good example of this methodology as DDR4 has practically been phased out by its next-gen equivalent. We've pieced in some of our favorite Corsair Vengeance DDR5 DIMM sticks here to help run alongside our zippy new AM5 processor. Also, one of our favorite SSDs of recent times, the SK Hynix Platinum P41, makes its way on board for excessively speedy storage performance.

INGREDIENTS

PART		PRICE
Case	Phanteks Eclipse P400A ATX Mid Tower	$100
Mobo	Asus ROG STRIX B650-A GAMING WIFI ATX AM5	$280
CPU	AMD Ryzen 7 7700X	$349
CPU Cooler	AMD Wraith Stealth	$N/A
Case Cooling	Noctua NF-F12 industrialPPC-2000 120mm Fan (x3)	$84
GPU	NVIDIA Founders Edition GeForce RTX 4080 16GB GDDR6X	$1,529
Memory	32GB (2x 16GB) Corsair Vengeance DDR5-4800MHz	$120
SSD	1TB SK Hynix Platinum P41 PCIe 4.0 NVMe SSD	$150
PSU	NZXT C1000 1000W 80+ Gold PSU	$180
OS	Windows 11 Home 64-bit OEM	$32
TOTAL		**$2,824**

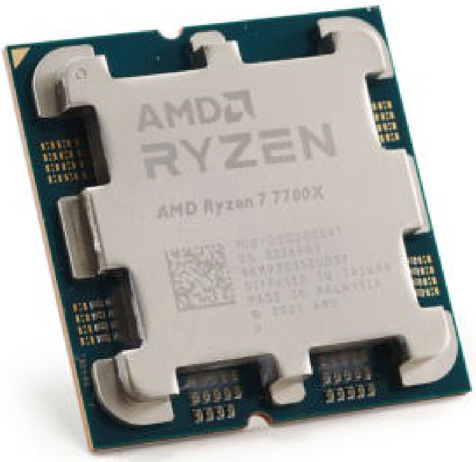
PRICES CORRECT AT THE TIME OF PRINTING



STRIX
REPUBLIC OF GAMERS
AMD
AMD
FOR THOSE WHO DARE
GEFORCE RTX
PHANTEKS

STEP-BY-STEP BUILD GUIDE PG 22

WHAT'S IN THE BOX?



CPU

AMD Ryzen 7 7700X

Price: $349

Within the recently-released AMD 7000 series lineup sits the often overlooked yet understated Ryzen 7 7700X. Our Zen 4 captain of choice for our RTX 4080 gaming monster comes with eight threads and a total of 16 cores for reliable, effortless performance. As it's sporting the new Zen 4 architecture and AM5 socket, it's great for future proofing with DDR5 and PCIe 5.0 support. The chip is also manufactured using 5nm technology, which benefits from faster performance speeds and great power efficiency than the latter 7nm and 10nm processors. Also, at $350, it's well priced. **www.amd.com**

MOTHERBOARD

Asus ROG Strix B650-A Gaming WiFi

Price: $280

Our new Ryzen 7 7700X needs a new motherboard, specifically an AM5 board. This Asus B650 mobo is one killer piece of kit, with more than enough features to give it a healthy amount of longevity. It supports DDR5 and PCIe 5.0, features the latest WiFi 6E networking, and has AMD precision boost overdrive (PBO) overclocking capabilities accessible within the BIOS.

What makes this mobo great is its ease of use. The ROG Strix B650-A Gaming WiFi has BIOS flashback functionality, a PCIe slot Q-release button (very handy), Q-LED diagnostic lighting (also handy), and an M.2 Q-latch to make SSD installation even easier. It's a speedy board perfect for our chip and GPU combo and any future component changes. **www.asus.com**

STEP-BY-STEP BUILD GUIDE PG 22

GEFORCE RTX

GPU

Nvidia GeForce RTX 4080 Founders Edition

Price: $1,529

Expensive, vast, hard to attain, and a power-hungry monster. Not really some of the adjectives you'd like to attach to one of the latest advancements in graphics card technology, yet here we are. Thankfully, Nvidia pulled the plug on the lesser-powered original 12GB GDDR6X variant and opted to go along with 16GB of GDDR6X on the RTX 4080. This harvests enormous performance capabilities, which is no shock, but with the controversies around the steep pricing, especially on the reseller and second-hand market, it's hard to recommend this GPU at its recommended retail price.

Regardless, it'll account for most of the overall gaming performance within this system. Boasting a core count of 9,728 CUDA cores, these operate at a peak speed of 2,505MHz. That's quite the jump from the last-gen RTX 3080 which had just 8,704 with top speeds of 1,710MHz. The natural progression of faster clock speeds, larger core counts, and a larger cache pool results in this RTX 4080 trumping the previous 3080, and we can't wait to see how it performs in this PC. **www.nvidia.com**

CPU COOLER

AMD Wraith Stealth

Price: $N/A

Our CPU doesn't come with a stock cooler, so this was pulled from another system we had in our stock room. We won't lie to you here, this was not our intended method of cooling, we had a much flashier AIO alternative, yet things didn't go according to plan. We'll catch you up on that later through the build, don't you worry.

That said, there is nothing adversely wrong with a stock cooler, especially not with this AMD Wraith Stealth, given it saved our machine. Sure, it's wouldn't have been our first port of call, but AMD stock coolers have long been a great budget choice, while also looking as good as air coolers can. **www.amd.com**

WHAT'S IN THE BOX?

SK hynix
PLATINUM P41 NVMe

SSD

1TB SK Hynix Platinum P41 PCIe 4.0 NVMe M.2 2280 SSD

Price: $120

For our storage, we've chosen to use SK Hynix's Platinum P41 drive. Through previous experience, this SSD has stuck out as a dependable and quick M.2 drive, achieving read and write speeds up to 7,000MB/s and 6,500MB/s. It's a competitively priced SSD too, and as a result, is one of the best oerall SSDs on the market, especially considering the fast data speeds and efficient performance. This M.2 2280 SSD doesn't come with a heatsink though, so bear that in mind when selecting a motherboard. **www.ssd.skhynix.com**

VENGEANCE
VENGEANCE

RAM

32GB (2x 16GB) Corsair Vengeance DDR5-4800MHz

Price: $120

These RAM sticks aren't the flashiest of DIMM options out there, in fact, they don't flash at all. However, with most PC components, it's what's inside that counts. Random words of tenderness aside, these DDR5 sticks run at speeds of 4800MHz which is plenty sharp enough to maintain fast processing speeds alongside our AMD Ryzen 7 7700X, and with 32GB of capacity, these Corsair Vengeance sticks make for a great addition. Sure, four RGB sticks would be more aesthetically pleasing but you can't go wrong with a subtle black color scheme either. **www.corsair.com**

NZXT
MOTHERBOARD 20+4
CPU & PCI-E
PERIPHERAL & SATA
DO NOT USE MODULAR CABLES FROM OTHER POWER SUPPLIES
CPU & PCI-E
NZXT C1000

PSU

NZXT C1000 1000W 80+ Gold PSU

Price: $180

Much like the RTX 4090, the RTX 4080 also requires a power supply mighty enough to handle its resource-heavy performance. One important thing to check when using the new GPUs is how many PCIe ports on the PSU are needed. Our Founders Edition RTX 4080 requires three individual PCIe cables yet a recently used PNY RTX 4090 card needed a total of four. As our CPU also requires two of these ports, we needed a total of five CPU/PCIe connections, which this NZXT C1000 PSU had, making it a good match for our system. As it was also rated with a solid 80+ Gold efficiency, it was a no-brainer, although these 1,000W PSUs aren't the cheapest of components. **www.nzxt.com**

STEP-BY-STEP BUILD GUIDE PG 22

CASE COOLING

3x Noctua NF-F12 industrial PPC-2000 120mm fans

Price: $84

We pointed out earlier why we ended up using an AMD Wraith Stealth stock cooler. This issue also resulted in the front of our case needing some intake fans to keep our chassis nice and cool, plus it looks weird when it's empty.

When it comes down to fans, Noctua knows a thing or two about keeping a system cool. These fans have a top speed of up to 2,000rpm to keep a consistent high pressure of airflow. The industrialPPC line, which our fans fall under, has a high focus on outright performance over low noise, although these aren't excessively loud by any means.

We had these fans sitting in our stockroom from a previous build a while back, and found them to be a perfect fit to keep the interior of our rig cool, especially since it is housing the RTX 4080. So, these three 120mm fans will sit proudly at the front of our Phanteks P400A case and should draw in more than enough air to keep our machine running smoothly. **www.noctua.at**

CASE

Phanteks P400A

Price: $100

If it ain't broke, don't fix it. That's usually a dependable phrase to go by, and if we told you that we didn't choose our chassis based on that outlook, we'd be lying. This case is not new, but it provides great airflow, cable management, and room to build in without any over-the-top gimmicks. To house our system, we've got the base all-black version, which contains 2x 120mm fans and no RGB lighting. We were depending on our initial AIO cooler to provide some glitz and glamor to our machine but, as you may have guessed, that didn't go swimmingly. Anyway, this case still stands up as a great and lightweight sub-$100 chassis with an emphasis on cooling and airflow. **www.phanteks.com**

RTX 4080

GAMING PAIRED WITH ZEN 4 BRAIN POWER

LENGTH OF TIME: **2-3 HOURS**
LEVEL OF DIFFICULTY: **EASY**

GEFORCE RTX
PHANTEKS

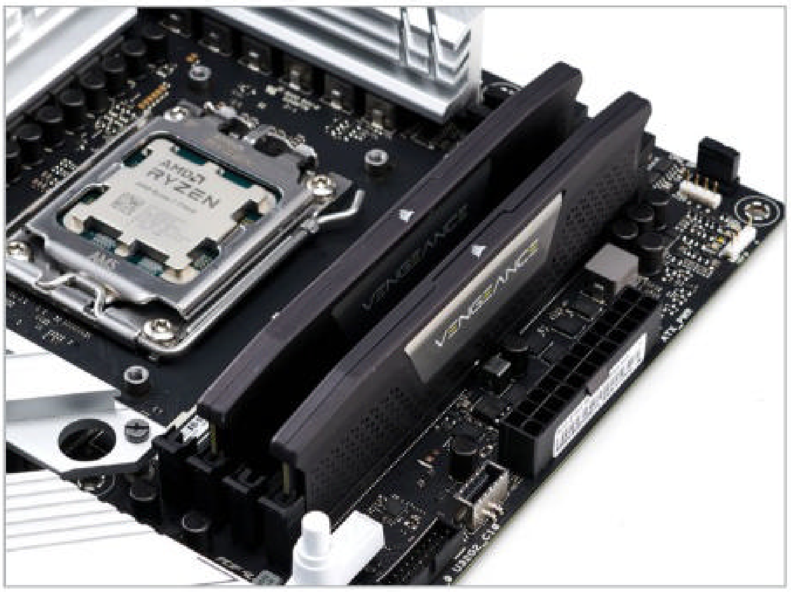
1 TEAR DOWN

IT'S PRACTICALLY become a tradition at *Maximum PC* that we start our builds by stripping our chassis down to the bare bones, so no reason to go changing things. The Phanteks P400A isn't too complicated, so tearing it down was a breeze. To remove the front panel, grip underneath the bottom with one hand while holding the case down with the other, then pull from the bottom to pop it off. The main glass window is held on with four thumbscrews, and to remove this we always recommend laying the case down on its back, given we've had close calls with glass panels slipping. The back panel has two captive thumbscrews, and once these are loosened, you can simply slide the panel out to remove it.

As you can see, this leaves us with a bare structure to work within, which is a good time to start thinking about potential cable management. Also, we have positioned both of the original case fans to be exhaust fans, one at the back and one at the top. These are held in by four short case screws.

4 DDR5, ENTER

THE NEXT STEP to perform is one of, if not, the easiest. When installing two sticks of RAM onto a motherboard with a total of four DIMM slots, check the original manufacturer manual first to ensure which two slots to prioritize. In our instance, this was slots two and four. After that, you need to push down the clips on each side of the slot to open it up. The RAM stick will either go in one way or the other, which depends on where the notch on the slot is. Align it so the notches from the stick and slot match, then you can press it down into position. You'll hear a satisfying click when the RAM has been seated correctly.



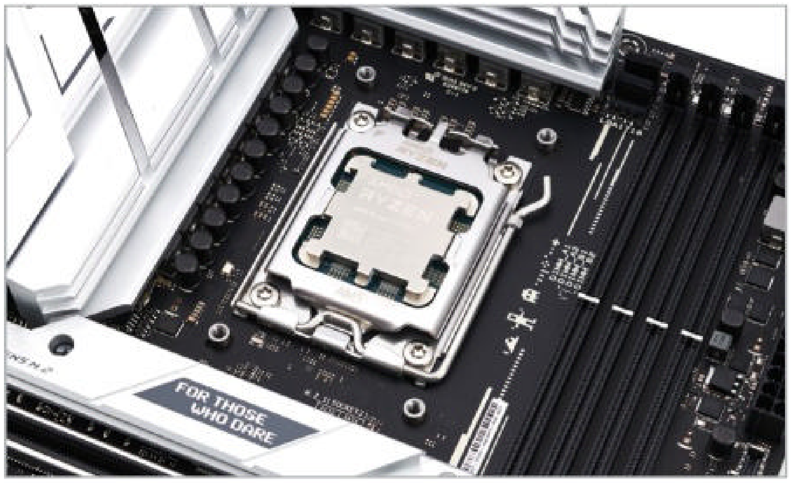
2 TOTALLY NOT RAD

SO THIS IS NZXT's Z73 RGB AIO, and it would have certainly spiced up the aesthetic of this build, but in this world, you don't always get what you want. We'll reveal why we didn't end up using this shortly, but just to run through what we were going for—we positioned our radiator on the outside with the three RGB fans on the inside. As these were going to be intake fans, we needed to make sure the faces of the fans were facing outwards. One of our favorite ways to remember which way round to position your fans is with the phrase "faces suck". These fans secure onto the radiator with the long screws included in the NZXT kit and with the radiator mount in between the both of them. We also made sure to position the cables facing the back panel so they didn't create a mess. All of these fans are daisy-chained together too, with RGB in/out cables and another cable that comes from the primary top fan which connects to the to the pump later on. As we say, we didn't end up using this for technical reasons though, sadly.

3 ZEN 4, ENTER

AIO ASIDE, WE can focus on getting the brain of our build, our tasty new AMD Ryzen 7 7700X, into our motherboard. To prepare the motherboard, we place it on top of the original box to keep it steady. Then, we open up the AM5 socket by pushing slowly down on the retention arm and easing it outwards to release the tension. Next, lift it up and the bracket will open up. To align the CPU to the correct position, make sure the arrows on the board and the CPU are together.

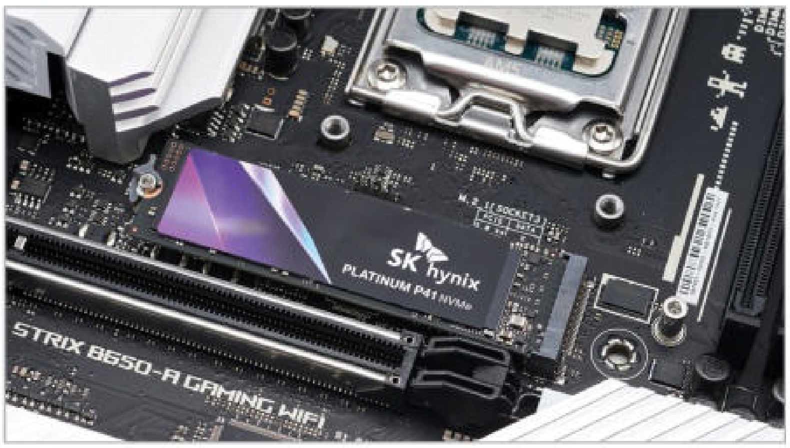
On the AM5 chips, the pins are now on the motherboard, so it's extremely important to still hold the chips from the side and to be careful when lowering it down into position on the board. Once secure on the board, we can start to do the reverse and bring the retention arm back down to secure the CPU onto the board.



5 M.2, ENTER

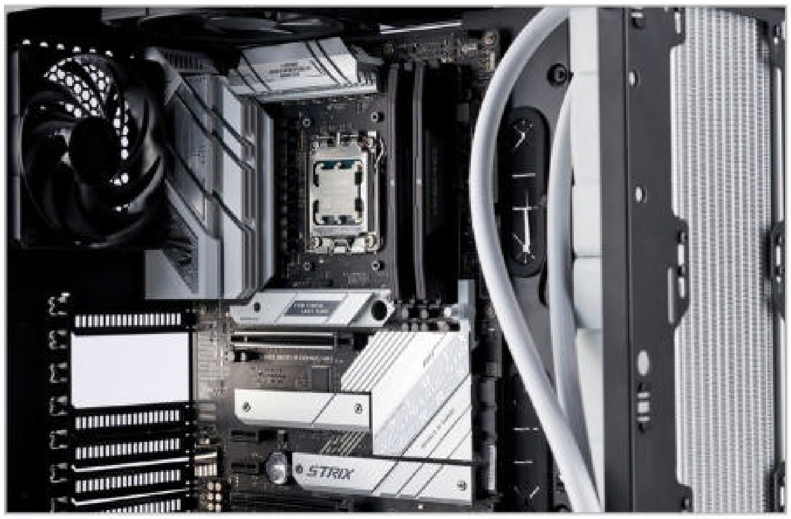
ANOTHER TYPICALLY EASY step is to install the SSD. Using a skinny Philips screwdriver, loosen the two screws on the uppermost M.2 heatsink. For us, Asus had branded this with some inspirational text, such as 'For those who dare', to keep us going and you know what? This certainly kept us motivated—who knows what we'd have done without it!

After the heatsink was off, we rested this to the side and began to lower our SSD by putting the connector into the port first. After that's done, lower it down and align the screw hole with the cutout on the SSD. The Asus motherboard came with a handy twist screw that secures the drive down, cutting out the use for those tiny M.2 screws that always go missing! Before screwing the heatsink back, remove the cover on the thermal pad, otherwise your SSD may get toasty, and we don't want that.



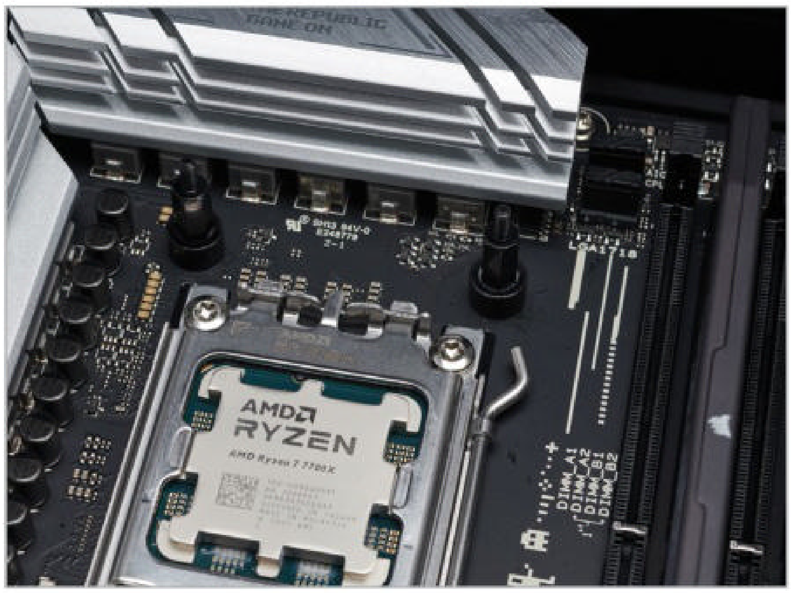
6 THE SHIP HAS LANDED.

NOW THAT WE'VE done as much external work on the motherboard as we can, we pair this together with its landing pad, our Phanteks P400A case. First off, and especially if you're using a previously used case, check you have all the necessary standoffs in place and they match the screw holes on your motherboard. Once confirmed, we can start off by aligning the motherboard's I/O shield with the gap in the back of the case and after that we can gently rest the board down. Carefully make sure the standoffs can be seen through all of the screw holes on the board. Then, working diagonally initially, tighten the board down onto the case using the case standoff screws. To avoid shorting the board, use as many standoff screws as possible.



7a PREPPING THE COOLER BLOCK

USUALLY, BEFORE ADDING the motherboard into the case, we would have added the CPU cooler bracket to the back. Thanks to Asus, this was already included and saved us some time, so hats off to those guys and girls! Anyway, for cooling, the AM5 socket chips can still use the same AM4 standoffs, so we took these and tightened them into the board. Make sure to install them as we have with the thicker part of the standoff at the bottom. Whenever installing an AIO, make sure to flick through the manual to ensure you're using the correct bracket and standoffs, as you'll want to ensure a secure connection between cooler and processor.



7b ADDING THE BLOCK

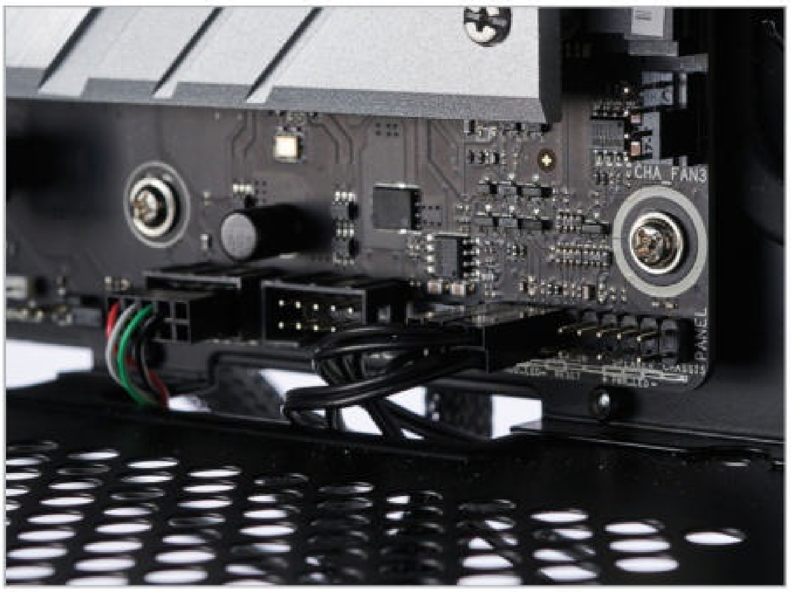
OUT OF THE BOX, the NZXT Z73 cooler block came pre-installed with the Intel Z690 bracket. To remove this, twist it slightly and it will pop off. Grab the AM4/AM5 bracket and attach it to the CPU block. This block also came with some thermal paste pre-applied, so if yours doesn't, add a pea-sized amount of thermal paste to your CPU at this stage. Then take the CPU cooler block, and gradually lower it onto your CPU, making sure that it's central and the bracket matches up with the standoffs. Once in position, you can take the thumbscrews from the kit and tighten it down. Before installing, consider where you want your ports on the CPU block to be. For us, it made sense for them to be towards the top so we could run the cables out that way.

9 FOUNDERS KEEPERS

THIS IS ONE hefty GPU. Before we get cracking, we need to make room at the back of the case by removing three PCIe cover shrouds. These are easy to remove and you just need a Phillips screwdriver to do so. Once we have some clearance, lay the case down and line up the PCIe connector with the port and press down until it clips into place. Make sure to use the uppermost PCIe port too. Then, using the three screws we just removed at the start of this step, screw it to the case. If you need to re-adjust, the motherboard has a handy quick-release button that opens up the PCIe clip.

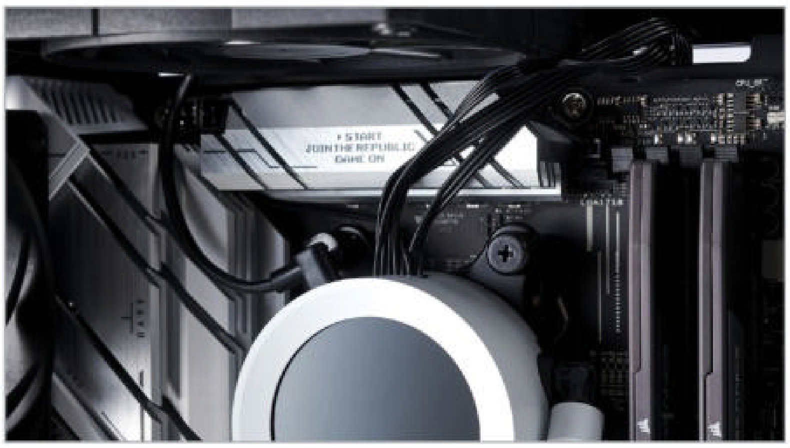
10 CASE CABLES

AFTER THE GPU has been seated, we need to connect the front panel case cables and fan cables to the motherboard before we run out of room. Unfortunately, these front panel cables are individual, which means another few minutes spent awkwardly connecting them to the board. These have to be the most awkward cables of all time, at least in our experience! Always refer back to the manual to ensure that you're connecting them to the right port, otherwise your power button might not work. At this point, connect the two case fans to spare fan headers on the motherboard and also attach the relevant USB connectors.



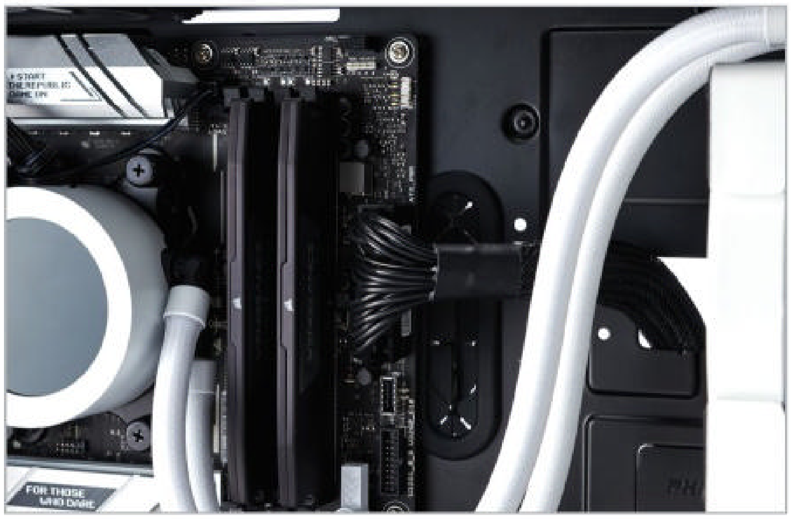
7c RGB CRAZINESS

RGB COOLERS ARE always more complicated than non-RGB, especially if they contain an LCD panel too, as this cooler did, as it means a few more cables to deal with. Out of the top came a SATA cable for power, a daisy chain to connect all the fan headers too, and also the RGB connector that links up to the other RGB cable coming from the primary top fan we mentioned earlier in step 2. Running these out of the top of the case, we connected them all up and kept things tidy by using the Phanteks P400A's cable channeling system. The pump also had to be connected directly to the motherboard header too, so we checked the Asus mobo manual to locate and connect that. One last connection was a micro-USB cable that came from the pump and connected to a header directly at the bottom of the mobo, we ran that out the top and around the back to the USB header on the board.



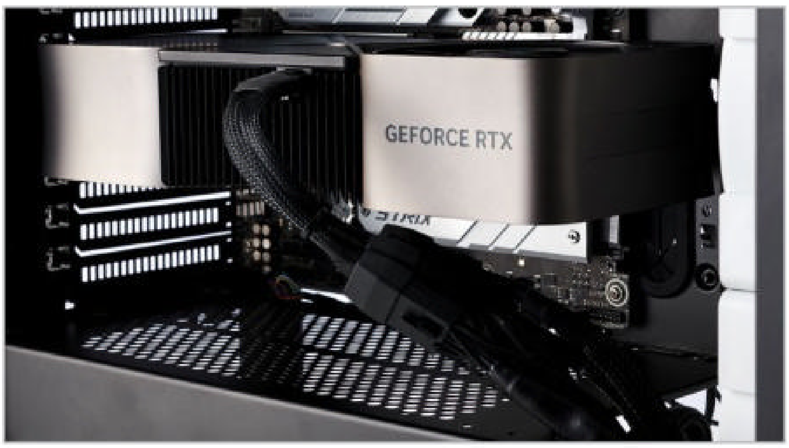
8 CONNECTING THE DOTS

NOW THAT ALL of the cooling is dealt with (for now), we can start to attach our PSU cables. It's always easier to attach them first to the motherboard than to connect them to the PSU first. For our build, we need two for the CPU, the 24-pin motherboard cable, a SATA cable, and three PCIe cables for our GPU as well. The PSU cables clip onto the board easily and only go one way. Think about the routes you want the cables to follow in order to help with cable management and keeping your build tidy. The trickiest was the CPU connections in the top right-hand corner as this space was very tight. We needed one full cable and then half of another which made it extremely fiddly. As for the SATA cable, that was out of the way and we'll focus on the PCIe cables shortly.



11 GPU SNAKE

ALONG WITH THE MIGHTY performance of the latest RTX 40 series cards also lurks a dreaded slithering heathen we like to call the GPU snake. Bearing three or, in some cases even four heads, this juggernaut of a serpent is a necessary burden to your build and can be frustrating even to those well versed in building. Gone are the days of connecting PCIe cables straight to the GPU, it now comes with a splitter. If this splitter was longer, we could easily tuck it down and out of the way, with the GPU snake finding its home hidden away in the basement of the case. Anyway, this contraption requires three individual cables with no daisy-chaining. Connect these to the splitter and then the splitter to the one port at the front of the GPU. We don't know why there couldn't be a splitter underneath or to the side to make this a prettier sight, but that's down to Nvidia's engineers, not us.



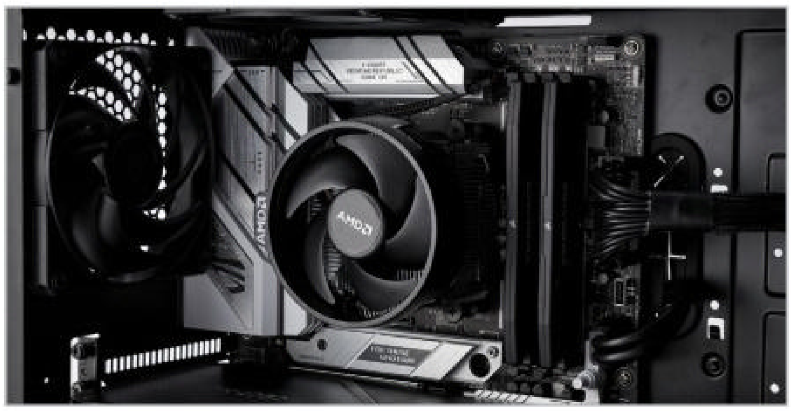
12 THE FINAL STAGE (ISH)

TO ROUND THE build off, connect the PSU cables to the back of the PSU, including the SATA, 24-pin, two CPU, and three PCIe cables. Make sure that these are neat and tidy around the back of the case, to keep the build organized. To attach it to the case, you need the four screws that come with the PSU, and we attach the PSU with the fan facing downwards. It's important to check the mesh tray underneath your PSU every once in a while to make sure airflow isn't being restricted. Anyway, line this up to the bottom of your case and screw it in using a Philips screwdriver. Before we go any further, don't get cocky as we did, and make sure to test your build before securing the PSU down. Cue a week's worth of troubleshooting and stress for your poor builder here.

13

UNLUCKY NUMBER 13

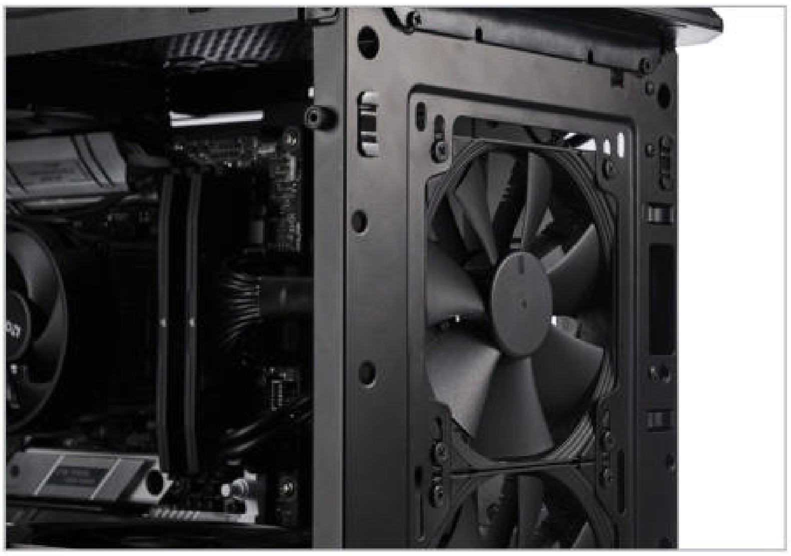
AS YOU CAN see in this picture, the NZXT Z73 AIO has gone, and in comes the old faithful AMD Wraith Stealth cooler. A week's worth of chaos ensued between this and the previous step, so what happened? We'll touch on this in more detail later—we did get some life out of the motherboard, but the system shut itself down after a few seconds. After working through everything to identify the problem, the last thing we tried was the cooler. Of course, that was the source of our problems but, unfortunately, we couldn't figure out why or get a replacement in time. So we undid all of our hard graft and removed it in favor of the AMD Wraith Stealth. As it's a stock cooler, installation is simple, especially as the motherboard had the cooler bracket already installed. We had to clean the CPU and add a fresh pea-sized blob of thermal paste. To install, line the screws with the screw holes, rest the cooler down on the CPU and tighten accordingly.



14

NEW LUNGS

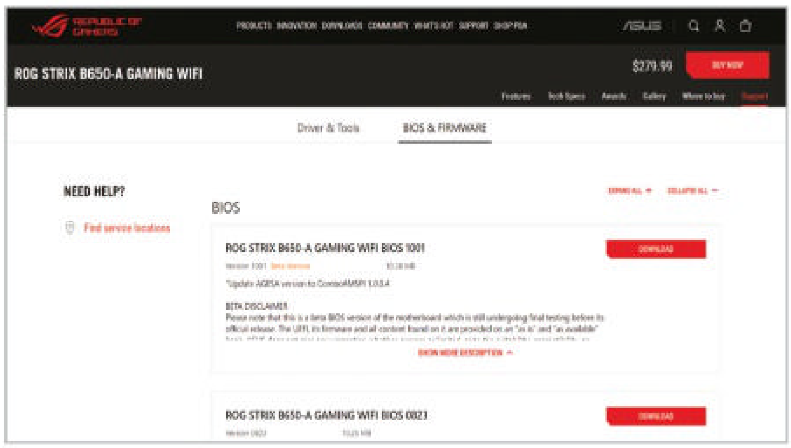
SO WE REPLACED the CPU pump header and now we have to replace the three fans we had to take out. To do just the job, we've brought in three Noctua NF-F12 industrialPPC-2000 blades to bring in a healthy dose of air for our system to breathe. These are just as easy to install as any other case fan, and we used four case screws to secure each fan onto the front bracket. To make the last and final cable management stage easier, we made sure the cables from the fans ran out of the back of the case too. The Phanteks P400A case has a fan daisy chain cable running around the back, so we hooked our Noctua fans to this, booted the system up. Thankfully, this time, we had life—and consistent life too, for that matter.



16

FROM HARDWARE TO SOFTWARE

NOW WE NEED to update our BIOS and install a clean copy of Windows 11. Our Asus motherboard thankfully comes with a built-in BIOS FLBK capability, updating the BIOS will ensure that the board is fully compatible with our AMD Ryzen 7 7700X. What you need is another system to download the BIOS update to, plus a clean USB thumb drive formatted to FAT32. On the other system, head over to the manufacturer's website and go to the support page for your motherboard. In the BIOS and Firmware section, download the latest file and extract it. Then run the BIOS renamer tool in the folder. Once the CAP file (BIOS update) has been renamed, drag this onto the root of your clean FAT32 formatted USB drive, making sure that nothing else but the CAP file is on there. We can now take this thumb drive, eject it safely and insert it directly into the motherboard BIOS USB port.



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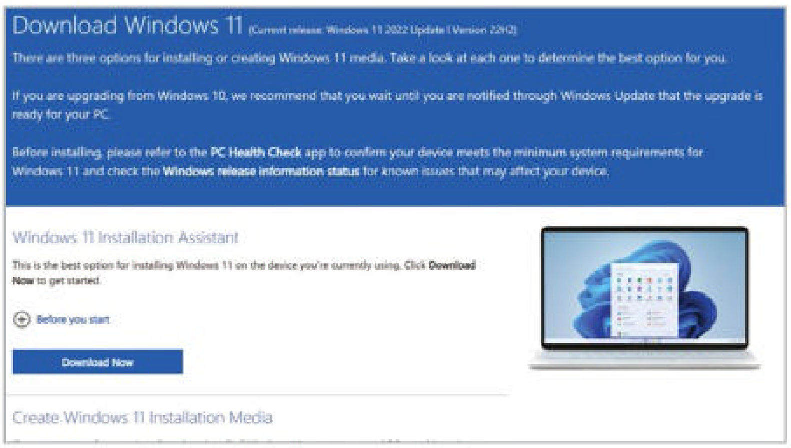
17

A WINDOW(S) OF OPPORTUNITY

MUCH LIKE THE BIOS update, we need another PC and also another USB drive formatted to FAT32 with at least 8GB capacity. On the other PC, go over to the official Microsoft website on the 'Download Windows 11' page and hit the download button under 'Create Windows 11 Installation Media'. Open the software once it's been downloaded, then run through the Installation Wizard. You'll then be asked to choose where you want to install your copy of Windows 11—choose your clean FAT32 drive, and proceed to download the OS. After this, head over to your new system, insert the memory stick, boot up your system, and if it doesn't automatically launch the Windows 11 installer, you'll be greeted with your BIOS. Within the BIOS, you can change the boot priority, make sure the USB drive with Windows 11 is the top priority, and restart—it should boot straight away into the installation process.



Download Windows 11 (Current release: Windows 11 2022 Update | Version 22H2)

There are three options for installing or creating Windows 11 media. Take a look at each one to determine the best option for you.

If you are upgrading from Windows 10, we recommend that you wait until you are notified through Windows Update that the upgrade is ready for your PC.

Before installing, please refer to the **PC Health Check** app to confirm your device meets the minimum system requirements for Windows 11 and check the **Windows release information status** for known issues that may affect your device.

Windows 11 Installation Assistant

This is the best option for installing Windows 11 on the device you're currently using. Click **Download Now** to get started.

Create Windows 11 Installation Media

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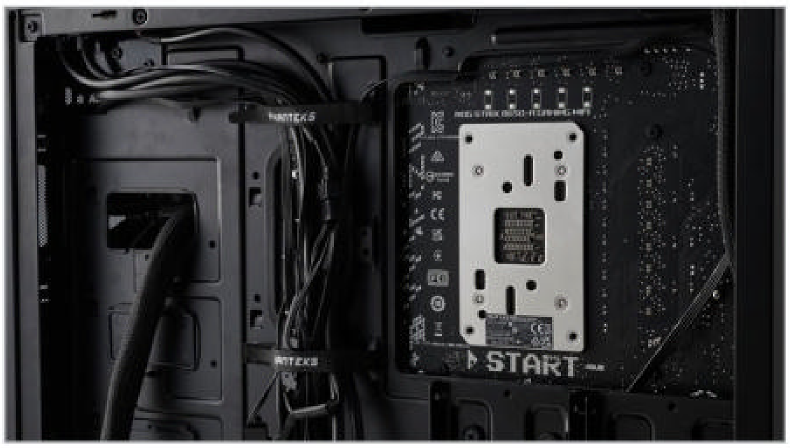
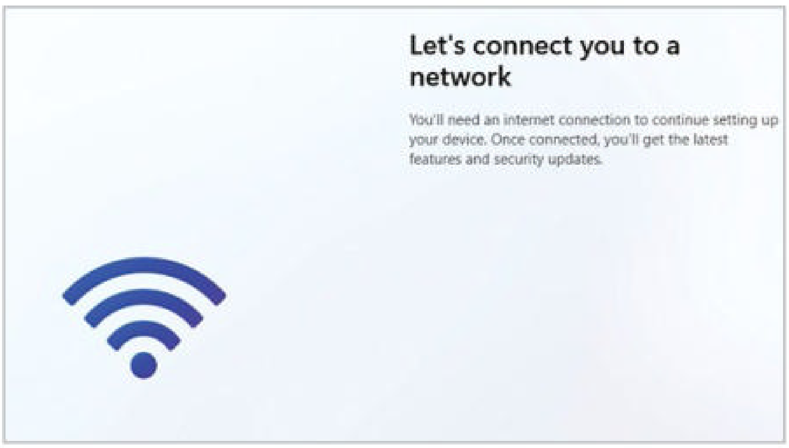
15 KEEPING IN LINE

NOW THAT we finally know our system can keep itself afloat, we can piece the case back together and get running on the software side of things. Yet there's one last thing to do for peace of mind — cable management. As you can see, we ran the majority of our cables down the main cable routing channel. This of course included our daisy chain for our fans which we managed to squeeze in here. Unfortunately, there wasn't quite enough room to fit the 24-pin motherboard cable in as these aren't exactly the most flexible. We also ran the CPU PSU cables straight down the right side of the back, as there was a very convenient route down there to hold the cables in place to run straight down to the PSU. Our feared GPU snake manages to just stay out of sight underneath the depths of the case. We removed the HDD cage to give it all the room it needs to stay down there, too!



18 JUST WHY WIFI?

WHEN GOING THROUGH the Windows 11 installation wizard, we got to the 'Let's connect you to a network' stage, and unfortunately, there was nothing to be seen. The problem here is that there used to be an option to click if you didn't have internet, then you could download or update your WiFi drivers later on. Yet, that option for us was just not there. Fear not, however, as we have a solution for you if this ever happens to you. First, you need to bring up the command prompt by pressing both the Shift key and F10. Type in exactly 'OOBE\BYPASSNRO' and press enter. The system will restart and then you'll be greeted with that option. Once into your new PC, use another PC and USB drive to install the relevant networking drivers needed for your system and install them. From there, you'll be able to update everything and start enjoying your new build.



Let's connect you to a network

You'll need an internet connection to continue setting up your device. Once connected, you'll get the latest features and security updates.

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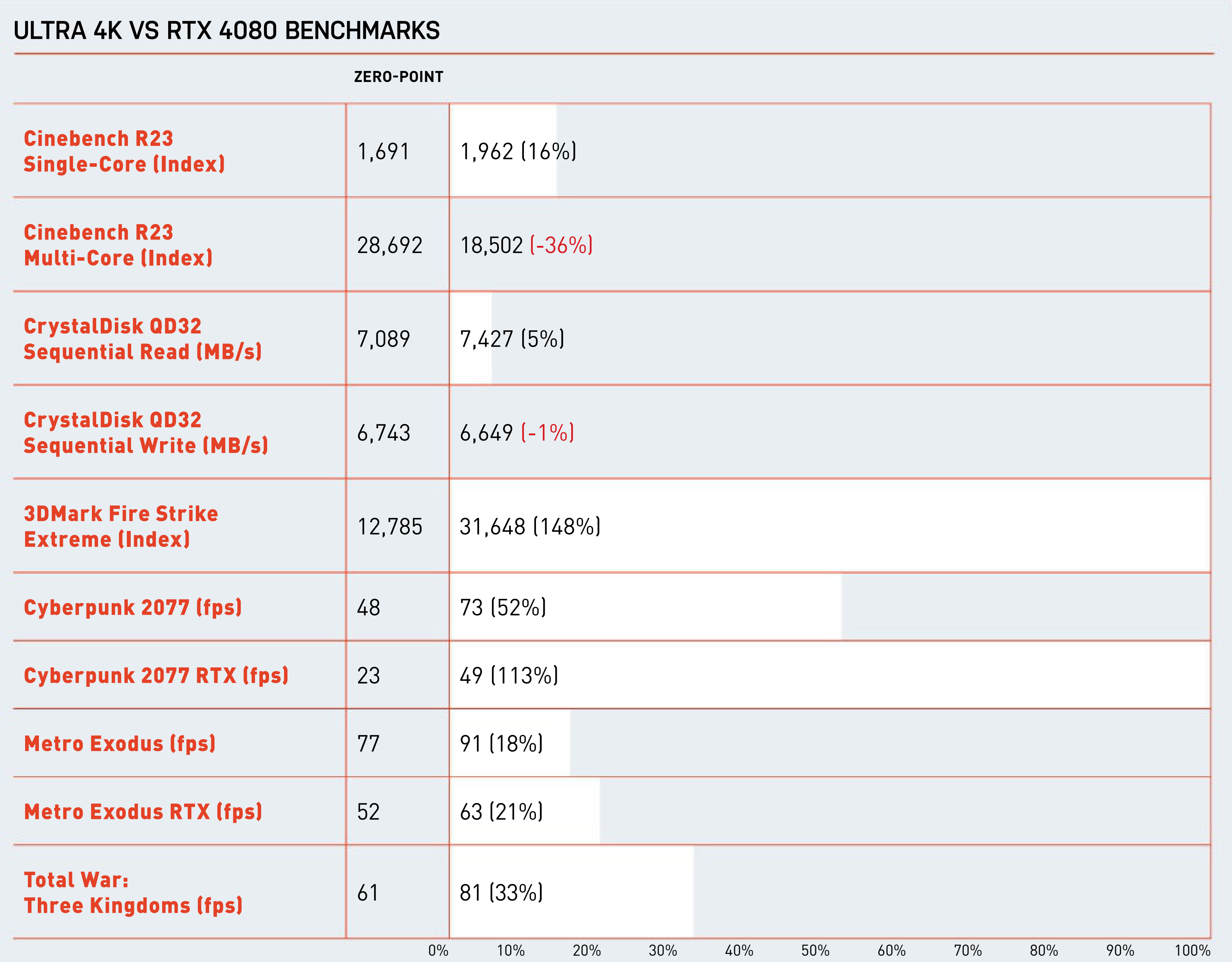
THE RESULTS

With everything finally in working order, how does this

THERE ARE MANY ways you can judge how a PC performs and sometimes stats and figures can often make you think differently about a product depending on what it's compared against. That's why we pitted this machine against our Ultra 4K machine from our July 2022 issue. That benchmarking PC was one of the best showcases of the last generation and came in around the $3.5K price point. If we can better these figures, then this will be a great success for this build as we have managed to piece this RTX 4080 machine together for less than $3,000. After running our new system through the same resource-demanding tests, we did indeed better the Ultra 4K machine on all but two benchmarks, now we're more than happy with this outcome.

The RTX 4080 was always going to perform strongly. It's an awesome piece of equipment with performance in abundance, and gaming on this system rocked. Using the RTX 4080 makes gaming feel so effortless, bringing so much more immersion into the experience just because the graphics settings can be ramped up high. It's almost frustrating building these machines when you know that inevitably the mighty GPU has to be returned. Anyway, as you can see by our benchmarking table, we received reliably strong frames per second at 4K on all games, with *Cyberpunk 2077 RTX* being the only one to dip down below 60fps. For the 3D mark benchmarking we received a score of 31,648, which completely blew away the Ultra 4K machine. Overall, this was a great result for the 4080 build.



ULTRA 4K VS RTX 4080 BENCHMARKS

	ZERO-POINT	
Cinebench R23 Single-Core (Index)	1,691	1,962 (16%)
Cinebench R23 Multi-Core (Index)	28,692	18,502 (-36%)
CrystalDisk QD32 Sequential Read (MB/s)	7,089	7,427 (5%)
CrystalDisk QD32 Sequential Write (MB/s)	6,743	6,649 (-1%)
3DMark Fire Strike Extreme (Index)	12,785	31,648 (148%)
Cyberpunk 2077 (fps)	48	73 (52%)
Cyberpunk 2077 RTX (fps)	23	49 (113%)
Metro Exodus (fps)	77	91 (18%)
Metro Exodus RTX (fps)	52	63 (21%)
Total War: Three Kingdoms (fps)	61	81 (33%)

Our 1440p zero-point consists of an Intel Core i7-12700K, a Zotac Gaming GeForce RTX 3070 Ti AMP Holo, an MSI MAG B660M Bazooka, 16GB of G.Skill TridentZ Neo DDR4-3600, and a 1TB Samsung 980 Pro. All games tested at 1440p 'Ultra' graphics presets with DLSS/FSR and V-sync turned off. XMP/AMP for RAM speed turned on in all tests. No manual CPU overclocking.

monstrous machine perform?

AT THE TIME of building the RTX 4090 machine, we could manage to grab the PNY XLR8 Gaming VERTO EPIC-X RGB in that issue at retail price which meant an equivalent RTX 4090 build would also be under $3,000. Sadly, street prices mean that specific RTX 4090 is currently about $500 more than retail prices.

We weren't surprised that our RTX 4080 was outshone by the more expensive RTX 4090, but we were impressed that it didn't fall too far behind it across the board. For the near $500 difference, it seems like the RTX 4080 wouldn't be an awful choice to pick out of the two although we will admit, both are pricey. As for the chips, they were similar, especially when testing both single-core and multi-core Cinebench R23 benchmarks. Sure, the Intel Core i5-13600K did slightly top our AMD Ryzen 7 7700X, yet our AMD is still a fast processor that is more than capable of being put in a gaming rig. With its impressive efficiency, longevity, and easy overclocking with AMD EXPO, it makes a great brain for any new PC.

RTX 4090 VS RTX 4080 BENCHMARKS

	ZERO-POINT	
Cinebench R23 Single-Core (Index)	1,994	1,962 (-2%)
Cinebench R23 Multi-Core (Index)	20,687	18,502 (-11%)
CrystalDisk QD32 Sequential Read (MB/s)	6,967	7,427 (7%)
CrystalDisk QD32 Sequential Write (MB/s)	5,304	6,649 (25%)
3DMark Fire Strike Extreme (Index)	24,250	31,648 (31%)
Cyberpunk 2077 (fps)	87	73 (-16%)
Cyberpunk 2077 RTX (fps)	46	49 (7%)
Metro Exodus (fps)	123	91 (-26%)
Metro Exodus RTX (fps)	88	63 (-28%)
Total War: Three Kingdoms (fps)	103	81 (-21%)

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

Our zero-point consists of the slick and subtle 4090 rig from our January 2023 issue, featuring an Intel Core i5-13600K, PNY XLR8 Gaming VERTO EPIC-X RGB GeForce RTX 4090 24GB, MSI MAG Z690 Tomahawk Wi-Fi, 32GB (2x16) of Corsair Vengeance DDR5-4800, and 1TB WD_BLACK SN850 M.2 SSD. All games tested at 4K 'Ultra' graphics presets with DLSS and V-sync turned off and XMP for RAM speed turned on. No manual CPU overclocking.

IN CONCLUSION

A WILD GOOSE CHASE FOR A GOLDEN EGG

PICTURE THE SCENE. We were almost complete, every component attached, cables connected, and the day was going so well. We walk over to the outlet, connect up the PSU power cable, flick the switch on the wall, and then turn on the power supply itself. The motherboard lights come on and our hearts are filled with joy. We reach over to press the power button on the case, fans spin, lights come on, the pump header LCD panel shows a glimmer of hope, and then bam! The PC chokes and fails to boot up.

Our once joyous faces fall, the classic head scratching begins. We tried another PSU, reseated every single cable and component, and even shorted the connection on the power switch front panel pins to boot the system, but kept on getting the same result. We then dreaded the thought of the GPU or CPU being faulty and knew we didn't have any time to get alternatives, especially not another GPU. We had a backup build in mind, so we took all the components necessary to complete that build to our photo studio, as well as this build. After finishing another machine, that system also crashed and burned (not literally, thankfully) and was having motherboard issues, so we turned to the original system and tried something we hadn't yet tried, namely swapping out the cooler.

We overlooked this initially as being the component that was causing the system to post, as usually the system would still run for a little while before overheating and shutting down. Yet our system would turn on for a matter of seconds before failing. The bottom line is that the stock AMD Wraith Stealth cooler saved the day and we couldn't, unfortunately, get another NZXT Z73 RGB cooler quick enough to add it back to the system. We're still unsure exactly what part of the AIO failed, but these things happen and you have to be able to adapt. We're working to deadlines, but in the real world, we'd have filed the issue with NZXT and hoped for a quick replacement.

Regardless of the issues, what we ended up with was a system that proved how strong this spec is overall—and also how snappy the RTX 4080 is, despite its fairly steep price. We were mightily impressed by the performance of the AMD Ryzen 7 7700X CPU that orchestrated this build, especially when it came down to its efficiency.

As a chip that may get overshadowed by the faster, more premium Ryzen 7 models, this build proved it can hold its own and would be a great addition to a new build in 2023. This is a system that can do it all: game, design, create, work, procrastinate and have scope for improvements down the road.

Sure, it's not the flashiest of systems, especially since we had to swap out the RGB NZXT AIO, but it still ran fine with the air cooling alternative. We're impressed with how the system performs, it's just a shame we had issues and the RTX 4080 is currently somewhat too expensive right now.

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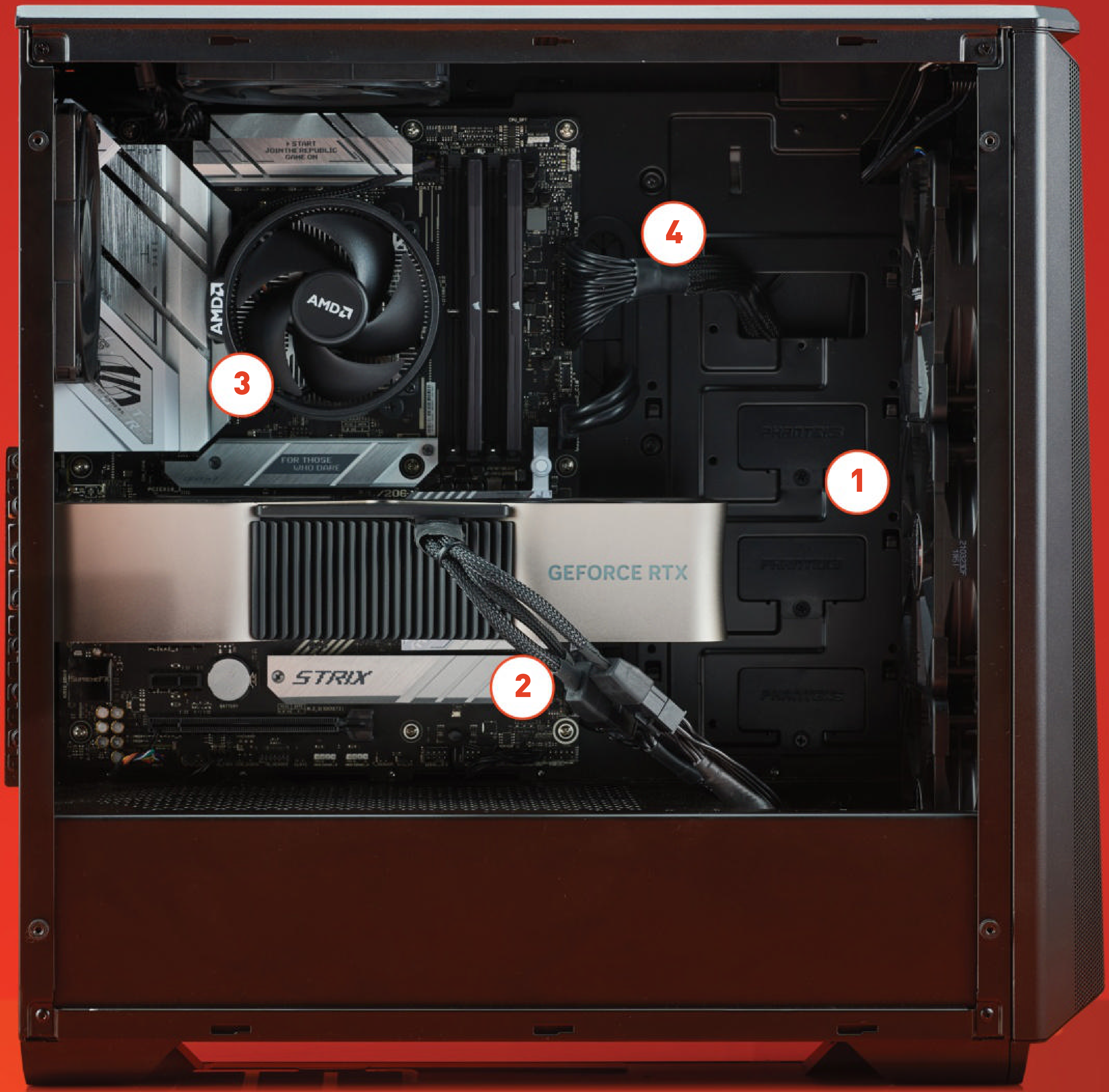
1 Of course, we would love to be showing you this build with the NZXT Z73 RGB in all its glory—but that plan was short-lived.

2 If only the PCIe splitter had been longer, we could have hidden the main bulk of the 'GPU snake' below the case.

3 Like the fan situation in the case, we were excited to feature the LCD CPU pump here, but we'll save it for another day.

4 It's a shame we couldn't tuck the 24-pin cable into the rubber gap directly next to it, but the angle was just a little too tight.



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BECOME A PODCASTING GENIUS

Podcasting is all the rage and there's never been a better time to get in on the action. But what will you need and how can you make it a success? Our guide reveals all **WRITTEN BY HOLLIN JONES**

PODCASTS have become incredibly popular in the many years since they started on Apple's iPod, and from which they derive their name. These days, you can listen to a podcast anywhere, streamed to your phone while on the move, or even on your Watch or Smart TV.

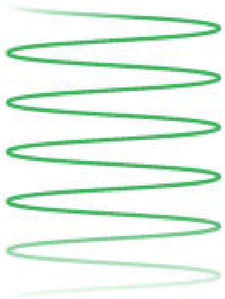
The variety of subjects they cover ranges from Advertising to Zoology, and that's because with a little time and the right equipment, almost anyone can create and publish their own podcast that could potentially reach an audience of thousands. Maybe you're passionate about a certain TV series or a particular sport. It's never been easier to share your interests with the world.

But podcasts don't just happen. In addition to a good idea for the subject and a potential target audience, you'll need some equipment to get that broadcasted to your listeners. And once you've refined your podcasting skills, there's the issue of monetizing your creation — how do you make your podcast pay? We'll be looking at what you need to create a great podcast with tips and tricks to guide you as well as some sources of advice and inspiration.

Hopefully, by the end of this feature, you'll discover that creating your own podcast is easier than you think, and who knows, maybe internet fame awaits? We've used GarageBand as the basis of this tutorial, as it's probably the easiest way to get started, but the techniques and ideas transfer over to the PC and Windows in the form of Audacity (free) or Adobe Audition, or indeed the free online Anchor app that Spotify publishes for budding podcasters. Let's get in the studio!

What you'll need

Build the ultimate studio by spending wisely where you have to, while getting what you can for free



An audio interface can handle the recording of several mics. Models like IK Multimedia's iRig Quattro work especially well with Apple devices.

CREATING A PODCAST is rather like making a radio show, or indeed a basic music recording using microphones. At its simplest, a podcast studio can be your desk or a spare room, preferably one that's away from unwanted background noise, such as a noisy road. If there's only going to be one person speaking, or two people sitting close together, you only really need one microphone. There are plenty of good quality USB mics for around $80–$120, such as those from Blue Microphones, Zoom, Røde and Shure. Some stand on your desk, while others need to be attached to a boom stand which will give you more flexibility, but can add slightly to the cost.

Most microphones tend to have integrated pop filters, which help you achieve a cleaner voice recording while reducing the peaks that can naturally occur when your mouth makes "p" or "t" sounds. In fact, some companies offer podcast hardware bundles with a microphone, headphones and audio interface, which are often sold for a fair bit less than their component parts. If you need two or more mics, you'll have to go with more traditional XLR-equipped models, and these will need to be connected to an audio interface or a mixer. IK Multimedia makes the iRig series, and the new iRig Pro Quattro I/O offers four inputs as well as compatibility across macOS, Windows and even Android and iOS. Dedicated podcast mixers do exist and can be pricier, but something like the RødeCaster Pro or Tascam Mixcast 4 will be designed specifically for mixing podcasts.

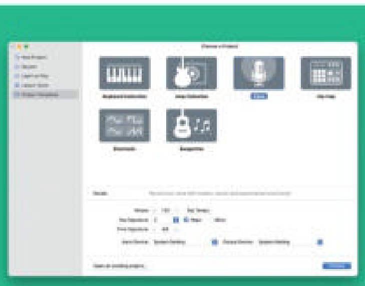
While these devices will add to the quality of your final recordings, so are a good investment if you're serious about your new hobby, as with all things, it can take a few goes to figure out if it's something you'll want to do long-term, and therefore whether it's worth the investment. We'd urge you to keep things cheap and simple if you're starting out, and a 2-in, 2-out USB audio interface can cost as little as $90 and will also offer great recording quality.

Decent headphones are a must for mixing, or speakers if your budget stretches. As recording, editing and mixing a podcast is similar to laying down music tracks, a free app such as Audacity or GarageBand is perfectly suited. GarageBand is the more user-friendly of the two, letting you set up and save templates to suit your needs. It's really about recording elements, editing them together, maybe adding music beds and other audio clips, followed by a little processing just to smooth everything out.

More specialized apps like Steinberg's WaveLab Cast are affordable and offer more advanced tools, and there's also Adobe Audition to consider if you're a Creative Cloud subscriber. For mobile, apps like Spreaker's Podcast Studio or Spotify's Anchor app are more stripped–

Top 5 podcast recording apps

To make your podcast, you'll need an application for Windows, Mac or mobile that can record multitrack audio, let you edit it and add some effects. Happily, there are plenty of apps around that fit the bill. Some are even completely free.



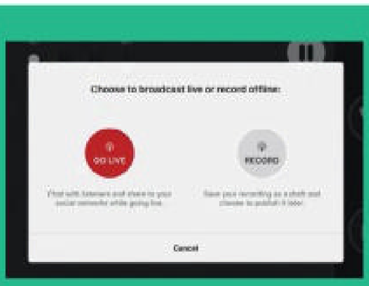
GARAGEBAND

Mac/iOS

$Free

From **apple.com**

If you're a Mac, iPad or iPhone user, we'd steer you towards Apple's free software, as it's the most user-friendly editing software out there. GarageBand is as adept with podcasts as it is with music. Record your voice tracks and add loops or music beds, as well as effects to give it a professional sound.



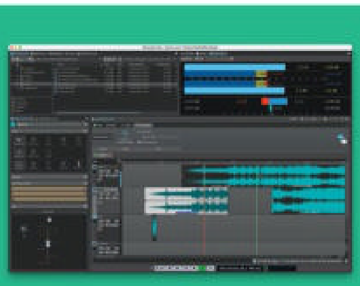
PODCAST STUDIO

iOS/Android

From **$8**

From **spreaker.com**

Running on mobile, Podcast Studio lets you record, publish, distribute and analyze your podcast, making it a great one-stop-shop solution. There's a free trial, but unlocking the full feature set does require an in–app purchase.



STEINBERG WAVELAB CAST

Windows/Mac

$70

From **steinberg.net**

Based on the WaveLab pro audio software, this has pro–grade recording and editing tools and effects for the discerning audiophile podcaster. It also connects to a number of distribution platforms, including Buzzsprout.

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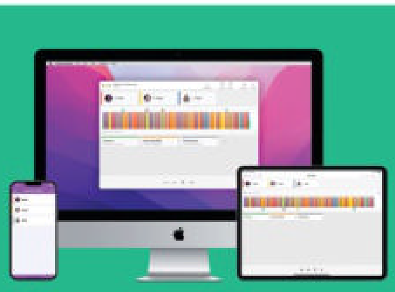
Many companies offer podcasting packs of a microphone, headphones, and audio interface to get you up and running.

down systems that you can use on the move. If your budget is limited, spend it on a decent microphone and a solid audio interface, since free apps offer all the basics. If you have loftier ambitions, trading up to WaveLab Cast or even Apple's Logic Pro will help the end result shine.



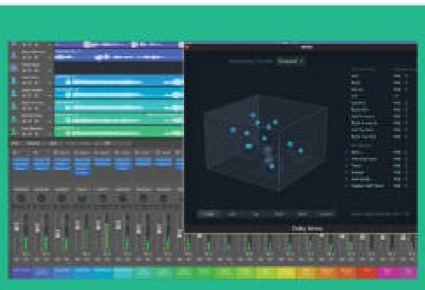
PODCAST STUDIO

Mac and iOS

From **$8**

From **podcaststudioapp.com**

This app aims to streamline the podcast process, automating the editing and using 'AudioMagic' to analyze sound, add effects, and improve clarity. Its Remote app lets others join in securely.



LOGIC PRO

Mac

$200

From **apple.com**

A serious app for serious podcasting, Logic Pro is the go-to app for many podcasting pros—and it's easy to see why. It takes everything you love about GarageBand and turns it up to 11 with plenty of powerful features. A free 90-day trial is available so you try it out.

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Top 5 podcast recording accessories/ hardware

To get the best sound quality, you'll need good hardware but this doesn't have to cost the earth. Here are some accessories that will help you on your way when paired with your computer, tablet or mobile.

RØDE NT1 KIT

$220

From **rode.com**

Popular with podcasting pros, this polar microphone comes with XLR connectivity, a pop filter (to help contain plosives) and a shock-absorbing suspension mount, making it incredible value.

IK MULTIMEDIA IRIG PRO QUATTRO I/O

$350

From **ikmultimedia.com**

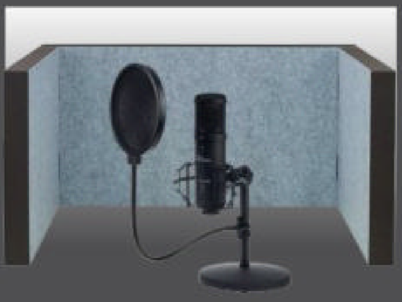
IK does make smaller interfaces than this, but the Quattro Pro is multi-talented, providing up to four powered XLR mic inputs and onboard mixing. It also includes cables and a microphone.

RØDECASTER PRO

$599

From **rode.com**

Pro audio specialists Røde make this four-input podcast powerhouse with wireless call integration plus echo canceling, audio FX processing and recording to SD card or computer. Yes, it's expensive, but it's a one-stop shop without the need for a computer or mobile device.



T.BONE SC 420 USB PODCAST PRO BUNDLE

$166

From **tbone-mics.com**

This is a great value bundle including a USB mic with headphone output, headphones, and a desktop stand. You also get an acoustic isolation panel to cut down external sounds.

KRK ROKIT RP5 G4

$189

From**krkmusic.com**

These compact, powered monitor speakers are designed for pro music production but are still affordable and will help you to fine-tune and polish your podcast. Having internal amplifiers means no need for additional power, either.

Create your first podcast

From deciding what to talk about and how to making your first recording

ONCE YOU'VE CHOSEN your hardware and apps, it's time to record your first podcast. Ideally, you should know what it's going to be about before you begin—and who your intended audience is—as well as whether your podcast is going to be a one-off or an entire series with a workable plan for each episode. In other words, think about the starting point, the journey and the destination.

It's important for you and your guests to know what the key talking points are, then structure each podcast accordingly. That will vary according to what works best for you, and indeed this may evolve over time. Some people will want to have every discussion point written down, complete with links to further reading if needed, and notes for each contributor ahead of time. Others will work better without any notes or preparation at all, especially if you prefer a more spontaneous, free-flowing end result. We'd urge you to over-prepare at first so that you have plenty to talk about in your episode, but remember, you can always pause and restart, or cut entire chunks out of your episode when editing—this is podcasting, not live radio, after all. If you stick to your prepared running order, you are less likely to test your listeners' patience by rambling.

Above all, think about your audience and how you are going to engage them and keep them listening. Think about what they might want to discover about your chosen subject and the reasons might they want to keep coming back. And finally, listen to lots of podcasts yourself—the Apple Podcasts, Google Podcasts or Spotify apps have thousands of hours of free and paid-for content that you can download and learn from.

We've asked some leading podcasting producers for their take—their insights are well worth taking onboard.

What you need to know about the podcast process

There's really no one-size-fits-all way to create and publish a podcast. What are the goals of your podcast—is it for fun? To meet people or serve a community? Get your business's name out, drive sales, earn money from advertising or sponsorship? Do you have a big budget, or does it need to be cheap? Is it going to be free to the listener?

Assuming you want your podcast to be public, then the big three players are Apple, Google and Spotify. Most podcast platforms will submit your podcast for you. There are a lot of other podcast directories but most of them will pull their information from Apple.

Podcast hosting platforms are a competitive space, but a popular one is captivate.fm — there's a whole ecosystem built around it, transcripts, websites, podcast players, plus it has good metrics. Buzzsprout.com and podbean.com are also easy to use, good-looking, and growing with flexible plans to boot. If you're recording your interviews, platforms such as riverside.fm, zencastr.com, and squadcast.fm will simplify the process and improve sound quality by recording your guests where they are rather than across the web.

Ultimately you can do it all more or less for free, but there are advantages in terms of speed and end results to sometimes getting some help with the production, distribution or marketing stages.

10 podcasts to listen to for inspiration

These are the 10 most popular podcasts in 2022 according to Edison Podcast Metrics. As well as noting the pretty extreme variety of subjects—proving that there's an audience for many different kinds of podcasts, and it takes all sorts—it's well worth listening to at least one or two of them to get a feel for how a successful podcast comes across to the listener. Instead of approaching it just as a listener, try to analyze the pacing, the format and the duration to see what blend of things it is that makes it a success. You never know, maybe you'll crack the Top 10 one day!

1. The Joe Rogan Experience
2. Crime Junkie
3. The Daily
4. This American Life
5. My Favorite Murder
6. Stuff You Should Know
7. Office Ladies
8. Dateline NBC
9. The Ben Shapiro Show
10. Call Her Daddy

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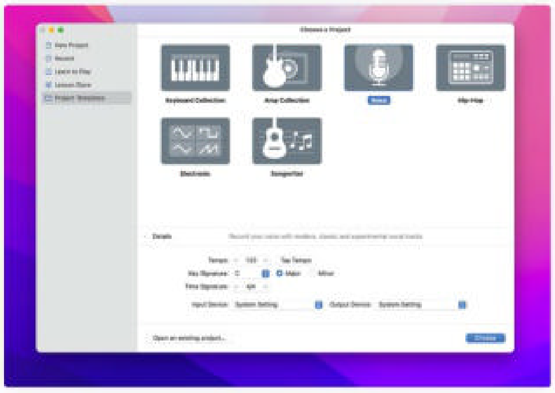
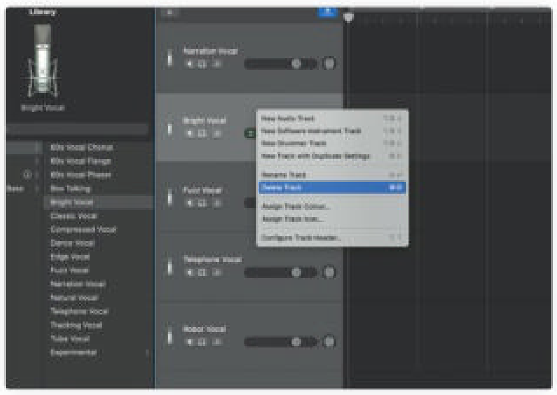
HOW TO Create your first podcast in GarageBand


Choose a Project
Keyboard Collection
Amp Collection
Voice
Hip Hop
Electronic
Songwriter
Details
Open an existing project...
Choose

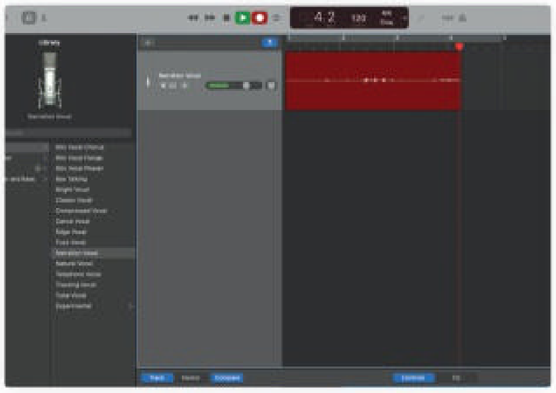
1. CREATE A PROJECT

With your mic connected, open GarageBand and make sure it appears in the Input Settings menu. Double-click on the Voice template to open a new project. It has four channels but you may not need them all yet.


Library
Narration Vocal
Bright Vocal
Fuzz Vocal
Telephone Vocal
Robot Vocal

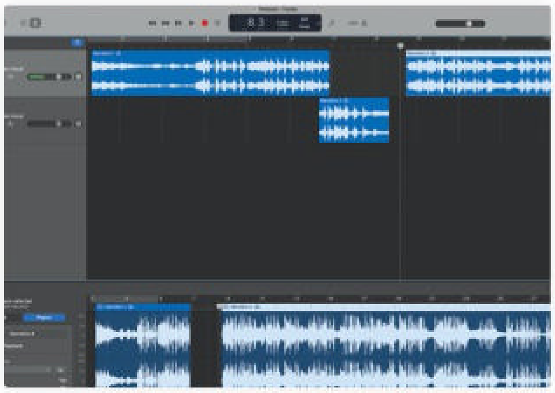
2. CHECK YOUR SIGNAL

Wear headphones or mute your speakers while recording to avoid feedback. For now, you can Ctrl-click on the other audio tracks to delete them. You should see signal showing on the track's level meter.


Library
Narration Vocal
4.2
120

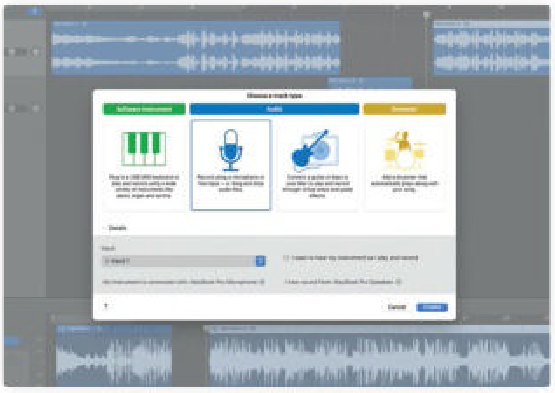
3. RECORD YOUR VOICE

By pressing Record, you can now record your voice by speaking into the microphone. If you find that it's either too quiet or too loud, try changing the level on the microphone, the interface or the audio track inside the app.



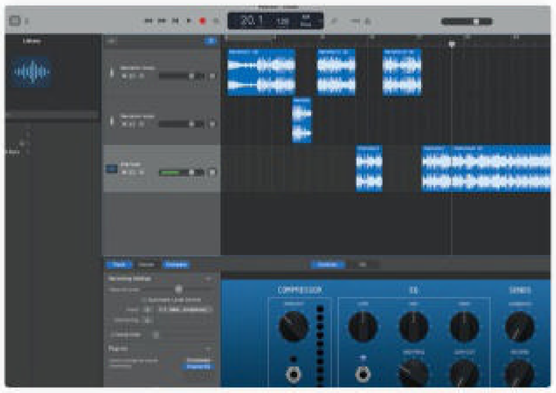
4. EDIT THE RECORDING

With some of your vocal track recorded, you can edit it by moving the playhead to the cut point and pressing Cmd+T. You will be able to drag and drop chopped clips anywhere, including on to new audio tracks.


Choose a track type
Software Instrument
Audio
Drummer
Details
Cancel
Create

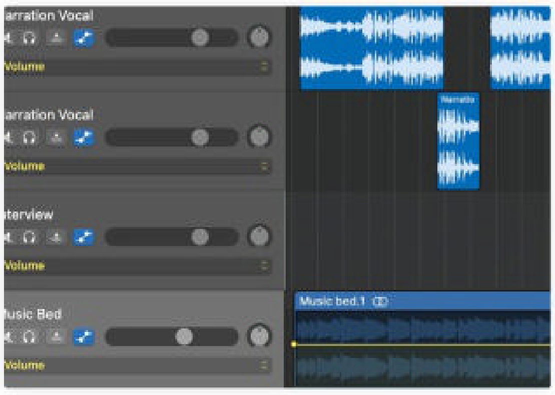
5. ADD MORE TRACKS

Use the "+" button to add a new audio track and record more dialog, or add two or more tracks to record multiple mics. Use the mute controls on existing tracks to silence anything you don't want to hear while recording.


20.1
120
Library
COMPRESSOR
EQ

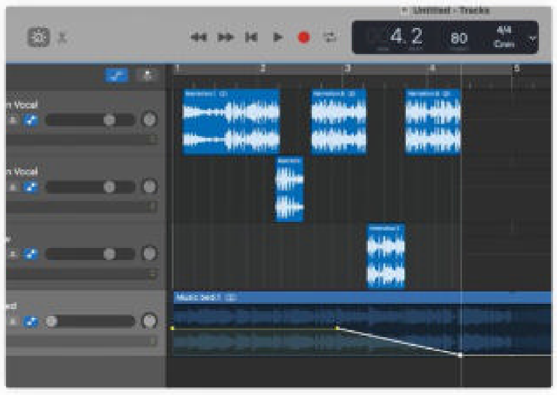
6. MAKE ARRANGEMENT

Use this edit technique to arrange your voice tracks so that all participants are heard. Use the level controls on the audio tracks to change volumes so they match. You can switch to loudspeakers when you've finished.


arration Vocal
Volume
arration Vocal
Volume
terview
Volume
usic Bed
Volume
Narration
Music bed.1

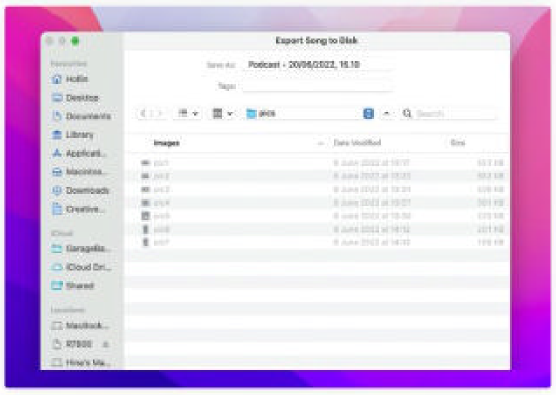
7. ADD SOME MUSIC

To add a jingle that fades out as you start speaking, import a music track, select it, then click the Show Automation button. Ensure that Volume is selected in the dropdown menu and a yellow line will appear along the music track.


Untitled - Tracks
4.2
80
4/4
Cmaj
n Vocal
n Vocal
Music bed.1

8. FADE MUSIC INTRO

Click the yellow Volume line to place a control point where you want the music to start to fade. Add another where you want the fade to stop. Drag the second point all the way down. The music will fade between the two points.


Export Song to Disk
Podcast - 20/06/2022, 15.10
Desktop
Documents
Library
Downloads
iCloud Drive
Shared
Images

9. TWEAK AND EXPORT

For each track, go to its Effects tab and make tweaks. Use an Equalizer (EQ) to shape the sound. When you're done editing and mixing, choose Share > Export Song To Disk. Then choose either MP3 or full-quality AIFF.

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Five podcast services that you need to know about

1 RIVERSIDE.FM
This web browser-based or Android/iOS app records high quality streams locally at up to 4K and uploads recordings to the cloud. Separating each participant into their own tracks, it has a "magic editor" to save you time and even features voice-to-text transcription. There's a free tier, but the standard pricing starts at $15 per month.

2 ZENCASTR.COM
Email a link to your guests and they can join your Zencastr session in their web browser. There's CD-quality audio recording with local copies for safety, 1080p video recording with up to four guests, VoIP chat, and Soundboard, which lets you insert intros, ads and other content. Automatic post-production can mix and export everything for you. There's a free plan, but the pro plan is $20 per month.

3 SQUADCAST.FM
Squadcast uses progressive uploading with auto-saving to the cloud, also recording files locally for safety. Your audio can be edited and processed and it integrates with other editing software. The $20 plan gets you audio-only recording with five hours per show, two team members and six other participants. The $40 plan expands this to video recording, 12 hours and up to 15 team members. Both plans include solid editing features.

4 BUZZSPROUT.COM
Buzzsprout is all about hosting and tracking the performance of your podcasts. It can help you push your podcast to all the top directories like Apple, Spotify and more, as well as getting statistics about listeners and their locations. There's a "magic mastering" tool for punching up your audio, dynamic content editing and transcription tools. The paid tiers start from $12 per month.

5 PODBEAN.COM
Podbean features an app for audio and video recording as well as tools for distributing your podcast. You also get a choice of monetization tools, including dynamic ad insertion technology that can help you to make money from your podcast. Detailed analytics are available too. The paid plan starts from $9 per month and offers a solid feature set.

Publish, schedule and promote

Get your podcast out there on to hosting platforms and start building your audience

WITH YOUR PODCAST now created, you need to get it out to the world to be heard. The easiest way to do this is to use a podcast hosting service. There are many of these, all with different feature sets and costs, but one that does get great reviews is Buzzsprout.

Services like this take care of the technical stuff for you, so your first step is to create an account with them, choosing the account type that best serves your needs. Then you "create" your show on the site, complete with text, pictures and all the information your listeners and potential listeners will need. After this, you upload your audio files—the podcast episodes—to your account, as many as you want to broadcast, and they are stored on the company's servers. You can host them yourself, but this is a much easier way to do things.

The host then organizes your files into a podcast feed that both you and them can supply to podcast directories like those from Apple Podcasts, Spotify, Google Podcasts, Stitcher, TuneIn, and other places people go to look for and listen to podcasts. Smaller podcast streaming services tend to take their feeds from the larger ones anyway, so you probably only need to submit to the top five or so and it should filter down.

When it comes to promoting your podcast, you'll need to do some legwork—having a social media presence and trying to engage with people and groups that are likely to be interested in your subject is a good way to start. You can use metrics supplied by your hosting company to see where your listeners are based and what kinds of devices they are using, and use this to help to target your promotion efforts.

It's also well worth having a decent website to go with the podcast instead of just relying on a Twitter account or podcast description. This way, people can see a bit more detail about who you are and what you do, maybe including some photo and video content.

Monetizing your podcast is connected with listener numbers and that's tied in to targeting

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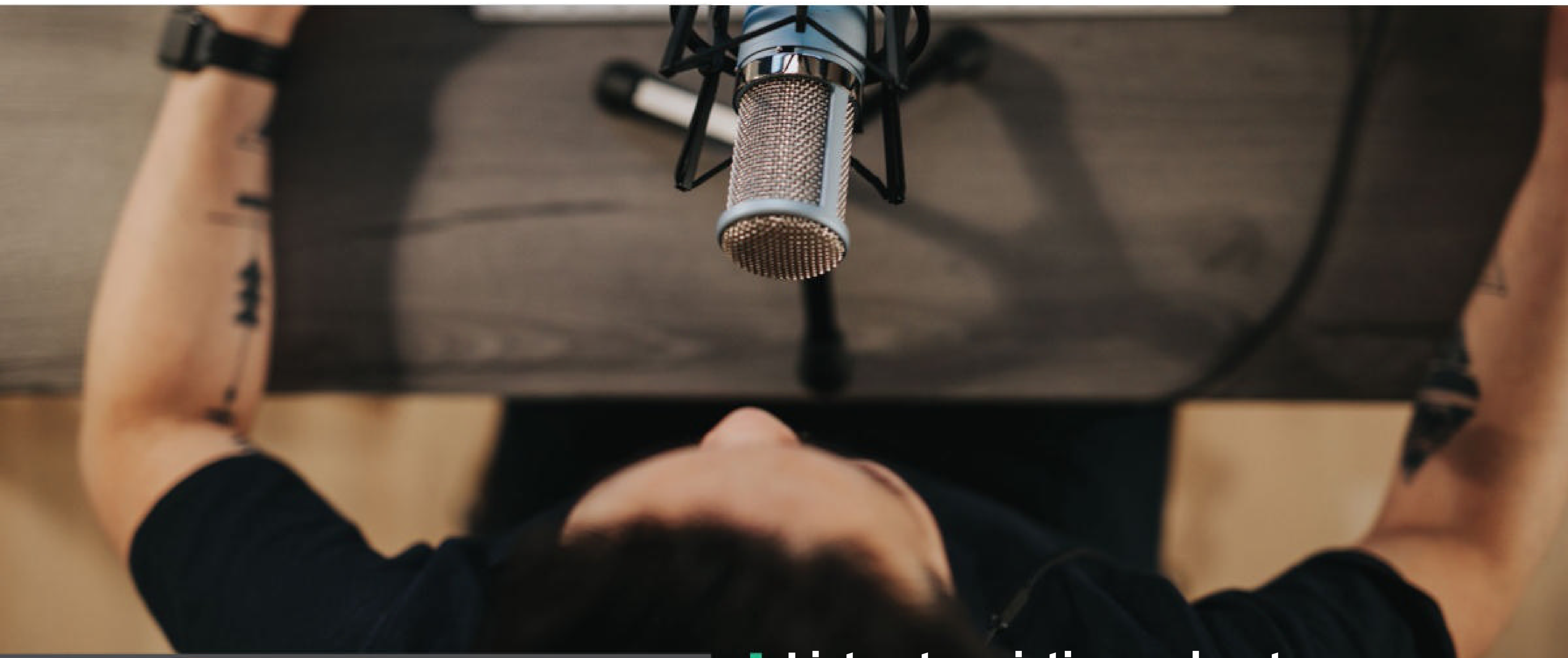
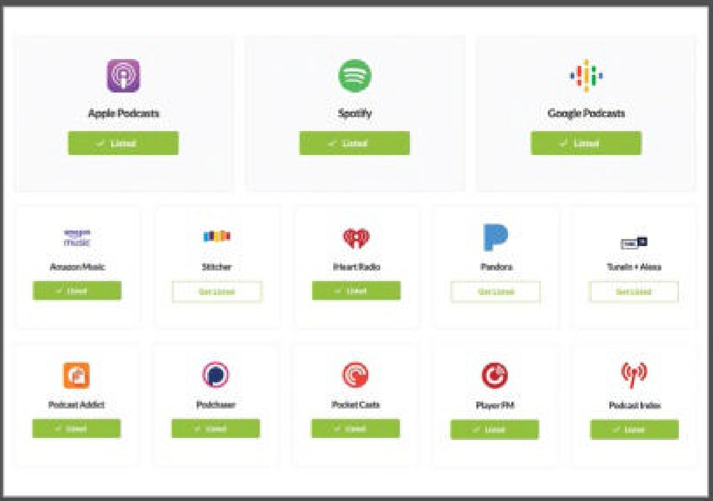


Listen to existing podcasts… to work out how a successful show is put together

the right listeners. Advertisers will be more likely to sponsor your episode (it can be more common to get weekly sponsors than permanent ones) if you can show them that your listeners are a demographic that they will also want to target. Random, YouTube-style "forced" ads are much less popular with listeners who may be minded to skip through them. A more personalized ad approach, maybe with the hosts discussing the advertised product or service, will make the listeners more likely to pay attention.

There's no guaranteed trick to having a successful podcast, but the key is to be passionate about your subject, and there will likely be an equally passionate audience out there for it. Listen to existing podcasts and break down how they are made—how long is an episode, how many guests do they have, do they use music? You can quickly work out how a successful show is put together. And if you love your subject, there's a good chance your audience will too.



Buzzsprout is one of the hosting companies that can get your podcast listed on all the big streaming providers like Apple, Google and Spotify.

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Top tips for creating your podcast —and finding an audience for it

1 Most producers would suggest that authenticity is key. There are huge blockbuster shows and niche podcasts, all with dedicated audiences that love listening to new episodes. The thing that popular shows all have in common is the feeling that everyone involved believes in what they're doing—that's why so many podcast fans want to give back by supporting or donating directly. Focus on something you love, have conversations you'd be having anyway and that will make for compelling content.

2 It's crucial to be consistent. With your releases, whether you're seasonal or weekly, pick a day and stick to it to ensure your show is a part of your audience's life. Also, think about where people who would like your show are and go to them. That could be forums, social media groups or even relevant in-person events. There are some great tools online to create audiograms and other bits of media to promote your podcast everywhere.

3 Identify a popular or underserved subject. Popularity is subjective depending on what you're covering. Going back to the idea of authenticity, doing a podcast simply because you think the subject might be popular isn't going to make for a compelling listen if you don't care about it. This might seem obvious, but ask yourself "would I listen to this podcast?" before you start making it. If it doesn't enthuse you, how will it enthuse anyone else?

4 Do your research. If the topic you've chosen is widely popular already, check out the competition and think about how you can differentiate your own approach. Being a carbon copy of something that's already out there is a risky strategy. You might have particularly good connections in a certain industry or field—think about how you could use those to your advantage.

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- **Boost** your USB stick's data-transfer speeds
- **Automatically** back up photos, videos, and other files to a USB stick
- **Discover** the true capacity of your USB stick
- **Tidy** your USB stick by splitting it into partitions
- Use a **portable file** manager to organize items
- **Index** contents to find files faster
- **Encrypt** files or a whole USB drive

CONSIDERING THEIR SIZE, simple designs, and cheap price tags, USB sticks are incredibly useful devices. Plug one into a port on your PC and you can quickly copy files and favorite tools from your hard drive to carry around with you and create backups of important data—without needing to install any software.

However, even if you are a frequent USB stick user, like us, there are always new tricks you can learn to improve your stick and the way you use it. Most *Maximum PC* readers will probably already know how to run different software from your stick, but it's equally helpful to know how to enhance its core function of storing your photos, videos, documents, and other files.

The more content you copy to a USB stick, the greater the likelihood it becomes slower, messier, and more prone to malfunction, making files more difficult to access and can causing data corruption.

Here, we reveal expert tips and tools for transferring files faster, whether manually or automatically, fixing common problems when saving items, organizing your USB stick so its contents are easy to find, and protecting your data from prying eyes, should your stick be lost or stolen.

We will also explain the best way to format your USB stick so that you can save and access all the files you need on any of your devices.

TRANSFER FILES FASTER AND BACK THEM UP

Copy files faster to your USB stick

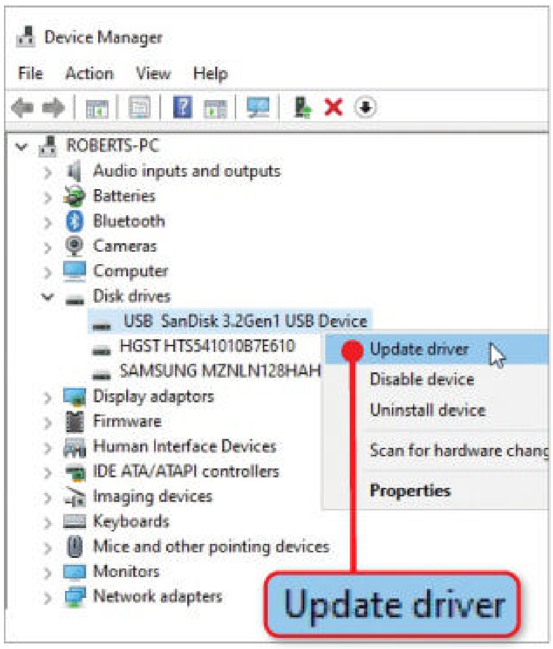
With USB sticks now offering huge storage capacities, you don't usually have to worry about the size and number of files you copy to them, but you may have to wait a while for large transfers, such as high-resolution photos and videos, to complete. If files are taking an inordinate length of time to copy over, there are a few tricks you can try to speed things up.

First, try inserting your USB stick in a different port, in case the current one is damaged and slowing your transfers. If that doesn't help, ensure that the drivers for your USB stick are up to date. To do this, open Device Manager by typing device manager into the Windows search box and clicking the 'Best match'. Expand the 'Disk drives' category, right-click your USB stick and choose 'Update driver' (see screenshot above right), then click 'Search automatically for drivers'.

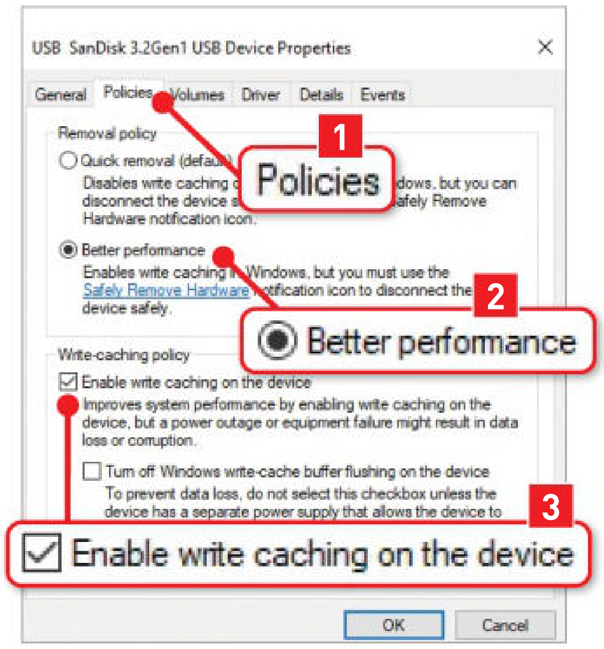
If Windows says the best drivers are already installed, try reinstalling them. Choose 'Uninstall device' in the right-click menu, unplug your USB stick from your PC and restart your machine. Plug the stick back in and Windows will automatically find and install the latest drivers. Next, try increasing your USB stick's maximum data-transfer rate. Right-click the Start button in Windows 10 or 11, or press Windows key+X, and select Disk Management.

In the Volume column of the Disk Management window, right-click your USB stick and choose Properties. Click the Hardware tab, select the name of the drive there and click Properties again. On the Policies tab (1 in our screenshot top right), select 'Better performance' 2 and tick the 'Enable write caching on the device' option 3. Click OK twice to confirm and exit.

With 'Better performance' enabled, you should ensure you always safely remove your USB stick from your PC. To do this, right-click its taskbar icon and choose 'Eject...', rather than just unplug it, or you risk losing or corrupting data.


Device Manager
File Action View Help
ROBERTS-PC
Audio inputs and outputs
Batteries
Bluetooth
Cameras
Computer
Disk drives
USB SanDisk 3.2Gen1 USB Device
HGST HTS541010B7E610
SAMSUNG MZNLN128HAH
Display adaptors
Firmware
Human Interface Devices
IDE ATA/ATAPI controllers
Imaging devices
Keyboards
Mice and other pointing devices
Monitors
Network adapters
Update driver
Disable device
Uninstall device
Scan for hardware chang
Properties
Update driver

Updating your USB stick's drivers may fix problems with its performance.


USB SanDisk 3.2Gen1 USB Device Properties
General Policies Volumes Driver Details Events
1
Policies
2
Better performance
3
OK
Cancel

Removal policy

○ Quick removal (defa

Disables write caching o dows, but you can disconnect the device s afely Remove Hardware notification icon.

● Better performance

Enables write caching i Windows, but you must use the Safely Remove Hardware tification icon to disconnect the device safely.

Write-caching policy

☑ Enable write caching on the device

Improves system performance by enabling write caching on the device, but a power outage or equipment failure might result in data loss or corruption.

☐ Turn off Windows write-cache buffer flushing on the device

To prevent data loss, do not select this checkbox unless the device has a separate power supply that allows the device to

☑ Enable write caching on the device

Tweak your USB stick's Disk Management settings to transfer files faster.

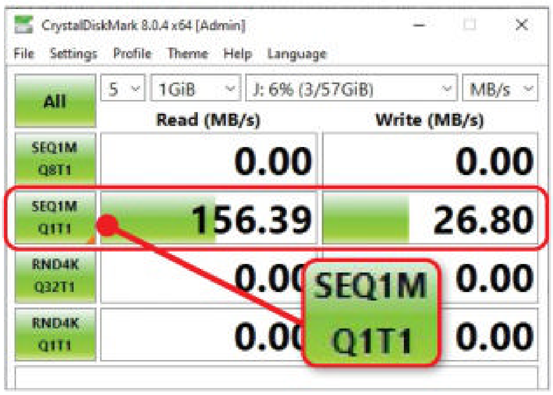
Test the speed of your USB sticks

If you want to copy a large number of files (or a small number of large files such as videos) to a USB stick in one go, it makes sense to use the fastest device in your arsenal. Speeds vary considerably between USB sticks and depend on factors including their age, capacity, how many times they have been formatted, and the USB technology they use. The latest standard, USB 3.2, theoretically offers data-transfer rates of up to 20Gbps, but in practice, you're unlikely to achieve anywhere near that.

To run a benchmark test over your USB sticks, download the free CrystalDiskMark (www.crystalmark.info) program, click the green Download button and choose the free Installer version. Insert a USB stick, launch the program, and select the drive in the dropdown menu. Click the green 'All' button to run the device through four thorough tests to ascertain how quickly it can read and write sequential and random data.

Alternatively, to save time, just click the SEQ1M Q1T1 test (see screenshot below), which provides results most similar to real-world use and takes around a minute to run.

Note down the read and write speeds detected by CrystalDiskMark, or click the File menu to save the results as a text or image file. Insert another USB stick and run the test(s) again to see if the new device's data-transfer rates are faster or slower than the previous device.


CrystalDiskMark 8.0.4 x64 [Admin]
File Settings Profile Theme Help Language
SEQ1M
Q1T1

All 5 1GiB J: 6% (3/57GiB) MB/s	Read (MB/s)	Write (MB/s)
SEQ1M Q8T1	0.00	0.00
SEQ1M Q1T1	156.39	26.80
RND4K Q32T1	0.00	0.00
RND4K Q1T1	0.00	0.00

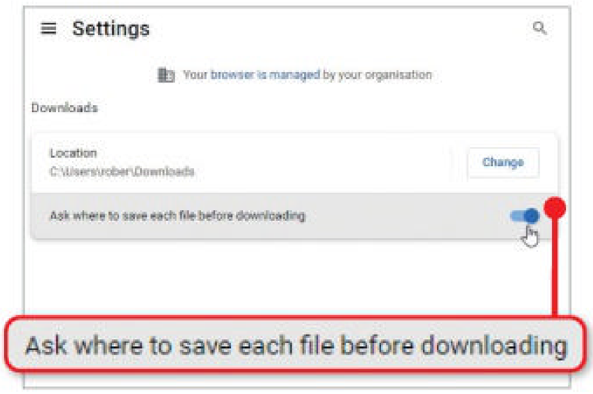
Test your USB sticks using CrystalDisk Mark to see which one is fastest.

Download files directly to your stick

Rather than downloading videos, MP3s, documents, and other files to your hard drive and then copying them to a USB stick, you can download them directly to a portable drive.

The easiest way to do this is to set your browser to ask you where to save files, so you can choose your USB stick as the download destination. In Chrome, Brave and Edge, go to Settings then Downloads, and select 'Ask where to save each file before downloading' (see screenshot below)—or 'Ask me what to do with each download' in Edge. In Firefox, choose 'Always ask you where to save files' on the General tab in Settings.

Alternatively, you can set your USB stick as your default download folder, so that files are saved to it automatically, provided it's plugged in. Click the Change button next to the current folder location in the Downloads section—or Browse in Firefox—and select your USB drive. This setting will also be used by extensions you use to save content from the web, such as YouTube video downloaders.


Settings
Downloads
Change

Your browser is managed by your organisation

Location
C:\Users\rober\Downloads

Ask where to save each file before downloading

Ask where to save each file before downloading

To download files to your USB stick, set your browser to ask where to save them.

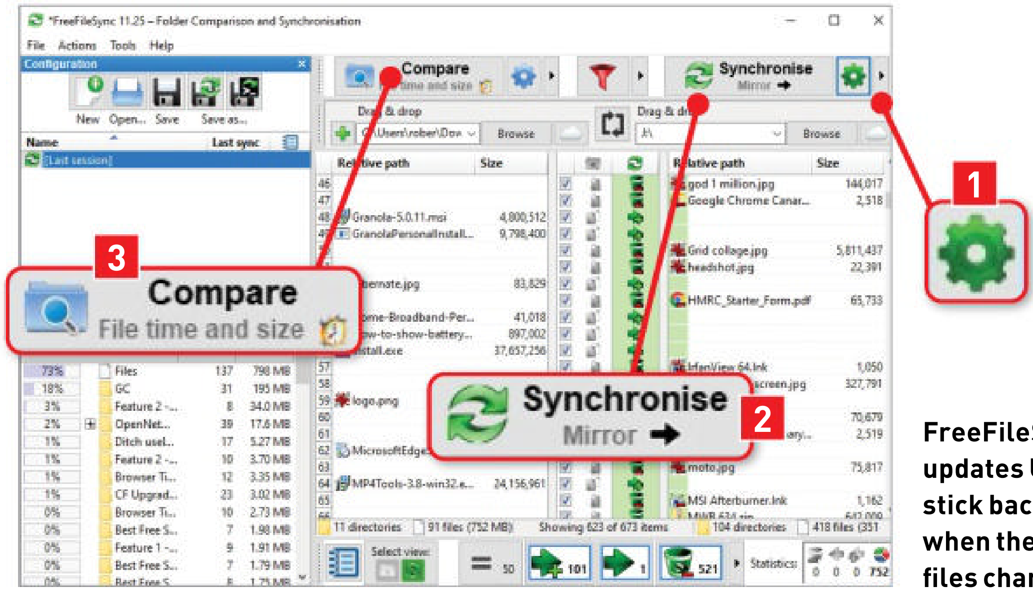
© SANDISK, CRYSTALDISK MARK

Sync PC folders with your USB stick

USB sticks are ideal for storing backups of important photos, videos, and documents, but when you make changes to items on your computer, you then need to copy the updated versions to your stick. Save yourself this hassle by downloading FreeFileSync (www.freefilesync.org), which detects when changes are made to files in specific folders on your computer, and updates their backup copies accordingly.

Install the free program, click Browse in the left-hand Compare column, and select a folder whose contents you want to sync. Click 'Browse' in the right-hand Synchronize column and select your USB drive. Click the green cog (1 in our screenshot above right) to decide how to sync the folder—'Two way' means that changes on either device will be reflected on the other, 'Mirror' will make an exact copy of the PC folder on your USB stick, and 'Update' will copy new and updated files from the former to the latter. Click the Synchronize button 2 then Start to perform the initial backup.

Save your settings and next time you open FreeFileSync, you can click Compare 3 to see which files in the folder have changed, then Synchronize to update the copies on your USB stick, without having to transfer everything again.


*FreeFileSync 11.25 – Folder Comparison and Synchronisation
File
Actions
Tools
Help
Configuration
New
Open...
Save
Save as...
Name
Last sync
[Last session]
Compare
File time and size
Synchronise
Mirror
Drag & drop
Browse
Relative path
Size
Select view:
Statistics:
1
2
3

FreeFileSync updates USB stick backups when the original files change.

Automatically back up files using File History

An even simpler, if less sophisticated, way to automatically back up important files to a USB stick is to use the File History feature in Windows 10 and 11. Plug a stick into your computer then type control panel into the Windows search box and select that option. Choose 'System and Security' then click 'Save backup copies of your files with File History'. Once Windows has detected your USB stick, click 'Turn on' and you'll see confirmation that 'File History is on' (1 in our screenshot below).

By default, File History backs up files in your Documents, Music, Pictures, Videos, and Desktop folders. You can remove any of these by clicking 'Exclude folders' and adding the folder to ignore. To copy files from other folders to your USB stick, type backup settings in the Windows 10 search box (Windows 11 won't let you add more folders), select that option, and click 'More options' under 'Back up using File History'. Choose the additional folders to back up, or click 'Add a folder' if they're not listed.

To change how frequently File History backs up files to your USB stick, click 'Advanced settings' and choose your preference in the 'Save copies of files' dropdown menu. The options range from 'Every 10 minutes' to Daily. You can also specify how long to keep saved versions—from 'one month' to Forever, or 'Until space is needed'.

To cancel automatic backups to your USB stick, simply click the button to 'Turn off' File History 2. Or, to use a different stick with more space on it, insert the new device and click 'Select drive'.

Back up emails to a USB stick

Keeping a copy of your emails on a USB stick allows you to access them on any computer, even when you don't have an internet connection, and means you can still read your messages should you close or get locked out of your email account.

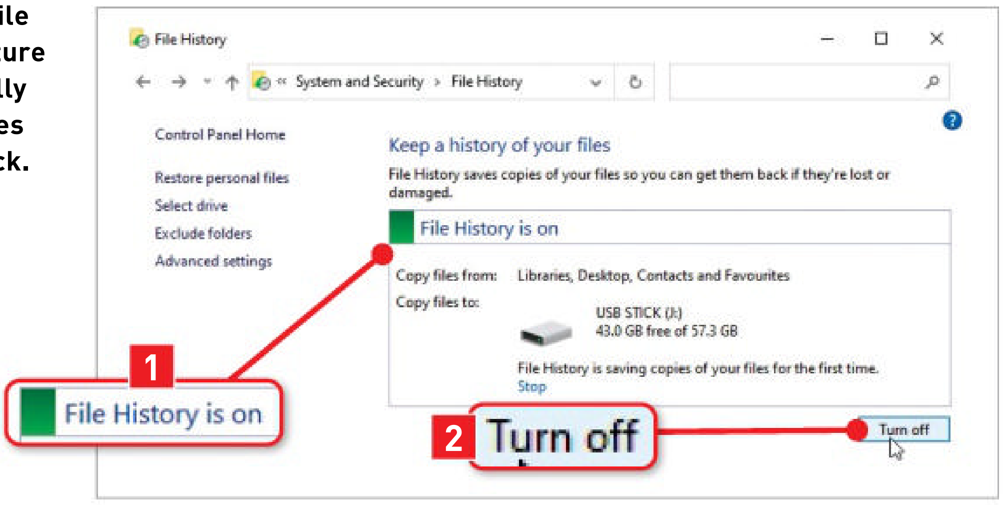
Thunderbird makes it easy to export all your emails, contacts, and settings to a ZIP file on a USB stick. Simply click the Tools menu, choose Export then click the Export button. Select your USB stick and click Save to copy your Thunderbird profile there. Alternatively, you can open the USB stick in File Explorer and drag and drop messages to it from your inbox—hold down Ctrl to select multiple emails.

Outlook offers the same option and also lets you save specific email folders to a USB stick. Click the File menu, choose 'Open & Export' then Import/Export, and select 'Export to a file'. Choose 'Outlook Data File', select the folder(s) to copy then click Browse, choose your USB stick and click Finish.

Gmail doesn't have an export option, but you can save a copy of your emails to a USB stick using Google Takeout. Go to https://takeout.google.com, click 'Deselect all' and tick the box next to Mail. Click 'All Mail data included' (see screenshot below) to specify which folders and other Gmail data you want to save.

Click 'Next step' then 'Create export' and you'll receive an email from Google containing a link from which you can access your Gmail archive. Click this to download a ZIP file containing your Gmail data to your USB stick.

Windows' File History feature automatically backs up files to a USB stick.


File History
System and Security
File History
Control Panel Home
Restore personal files
Select drive
Exclude folders
Advanced settings
Stop
Turn off
1
File History is on
2
Turn off

Keep a history of your files

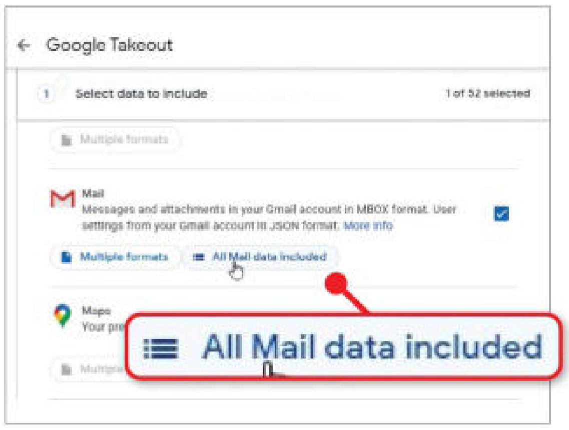
File History saves copies of your files so you can get them back if they're lost or damaged.

File History is on

Copy files from: Libraries, Desktop, Contacts and Favourites

Copy files to: USB STICK (J:) 43.0 GB free of 57.3 GB

File History is saving copies of your files for the first time.


Google Takeout
1
Select data to include
1 of 52 selected
Multiple formats
Mail
More info
Multiple formats
All Mail data included
Maps
All Mail data included

Messages and attachments in your Gmail account in MBOX format. User settings from your Gmail account in JSON format.

Use Google Takeout to back up all your Gmail messages to a USB stick.

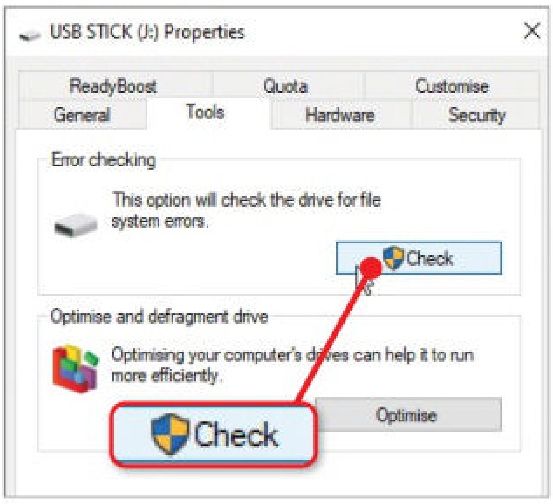
PREVENT AND FIX COPYING PROBLEMS

Scan your USB sticks for problems

Before you save important files to a USB stick, it's wise to check that the device is working correctly to ensure data is transferred successfully and remains uncorrupted and readable.

Windows provides its own tool for checking removable drives for errors. Right-click your USB stick in File Explorer's 'This PC' section, select Properties, and click the Tools tab. Click the Check button (see screenshot, right), then 'Scan and repair drive'. The tool may tell you the drive doesn't need to be scanned, but you can proceed anyway. If Windows finds any errors, it will attempt to fix them.

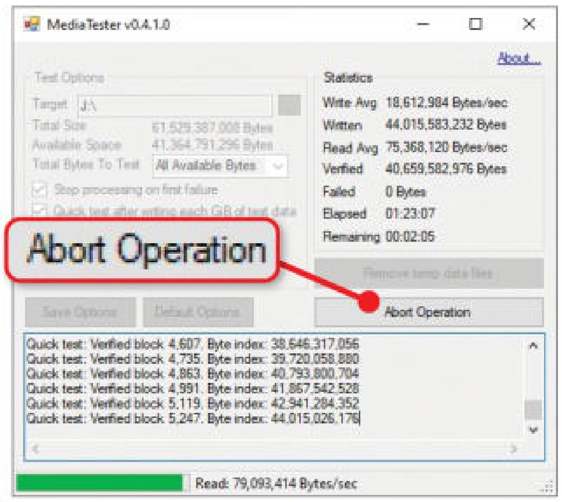
It's also advisable to scan a stick for malware before you save anything to it, both to protect your data and to avoid infecting the next computer you plug the device into. Right-click the USB drive again and choose 'Scan with Microsoft Defender'. Windows' built-in security tool will then check the stick for viruses and other threats, and display the results within a minute or two. If you use third-party antivirus software, select the option in the right-click menu to scan with that instead.



This option will check the drive for file system errors.

Optimising your computer's drives can help it to run more efficiently.

Scan your USB stick for errors before you save important files to it.



Target: J:\
Total Size: 61,529,387,008 Bytes
Available Space: 41,364,791,296 Bytes
Total Bytes To Test: All Available Bytes
☑ Stop processing on first failure
☑ Quick test after writing each GB of test data

Write Avg: 18,612,984 Bytes/sec
Written: 44,015,583,232 Bytes
Read Avg: 75,368,120 Bytes/sec
Verified: 40,659,582,976 Bytes
Failed: 0 Bytes
Elapsed: 01:23:07
Remaining: 00:02:05

```
Quick test: Verified block 4,607. Byte index: 38,646,317,056
Quick test: Verified block 4,735. Byte index: 39,720,058,880
Quick test: Verified block 4,863. Byte index: 40,793,800,704
Quick test: Verified block 4,991. Byte index: 41,867,542,528
Quick test: Verified block 5,119. Byte index: 42,941,284,352
Quick test: Verified block 5,247. Byte index: 44,015,026,176
```

Read: 79,093,414 Bytes/sec

MediaTester checks the real capacity of your USB stick to ensure it's not a fake.

Discover the actual size of your USB stick

Many cheap USB sticks with impressive-sounding capacities, usually around 1TB or more, are actually fakes that offer nowhere near their claimed amount of storage. This can result in files you copy to them becoming corrupted because there's not enough available room. Even if Windows says your device has plenty of free space, it may be accepting the fake claim, so it's worth checking the actual size of your stick before you transfer any content.

One way of checking the actual capacity of your USB is with the free MediaTester tool (www.tinyurl.com/2bcuc7xz). Download the files, launch the program and click the two-dot Browse button next to the Target box. Select your USB stick, click OK and choose 'Write and Verify'. The program will then copy test data to your device until it reaches the reported capacity to see how much space is really available.

MediaTester will abandon the test as soon as it detects an error, which indicates that the manufacturer of your USB stick is making a false claim about the amount of storage. If the test completes without any errors, then your USB stick is genuine. This may take up to a couple of hours, depending on the size of the drive, but to save time you can click Abort Operation (see screenshot above) once a large portion of data has been verified.

For the best results, MediaTester recommends you test an empty device, but it will still work on USB sticks that contain files and, unlike some rival tools, it won't overwrite the data on them.

What's the best way to format USB sticks?

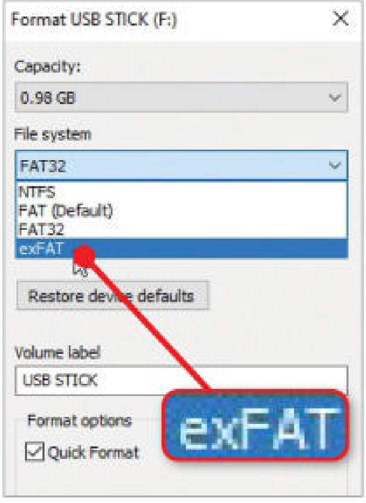
Formatting a USB stick, whether to prepare it for data, wipe its contents or fix problems, is a straightforward task: simply right-click its drive icon in File Explorer and click Format.

Either select 'Quick format' in the box that opens to speed up the process, or untick that option to perform a full format, which will scan your stick for bad sectors and overwrite its data.

However, confusion can arise when faced with the 'File system' menu—should you choose FAT32, exFAT, or NTFS? If you format your stick using FAT32, it will be compatible with a wide range of computers and devices, including smart TVs.

Due to limitations built into this file system, Windows only lets you use FAT32 to format drives and partitions of up to 32GB in size (some third-party tools can beat this restriction), and you can't store individual files larger than 4GB.

In contrast, NTFS places no practical limits on the size of drives, partitions, and files, and offers extra features such as creating shadow copies for backup.



Capacity: 0.98 GB
File system: FAT32
Volume label: USB STICK
☑ Quick Format

However, it's only compatible with Windows and does have some restrictions, such as requiring Secure Boot to be disabled when you want to boot from an NTFS-formatted drive. This has caused problems with the Windows 11 ISO file, which at 5GB is too large to copy to a FAT32 drive, but requires Secure Boot to run.

The brilliant free tool Rufus (rufus.ie) offers a clever workaround, by installing Windows 11 from an NTFS drive without the need for Secure Booting.

That leaves exFAT (see screenshot), an updated version of FAT32 that removes most of that file system's size limitations while retaining its compatibility with non-Windows devices. It's fast and space-efficient, allowing you to use nearly every byte of available storage, so is the best choice for formatting USB sticks.

On older, smaller-capacity devices, exFAT may not be available, so you'll need to use FAT32. The free program IM-Magic Partition Resizer Free (www.resize-c.com) will let you format USB sticks larger than 32GB as FAT32.

© GOOGLE, MEDIATESTER, FREEFILESYNC

Remove write protection from your stick

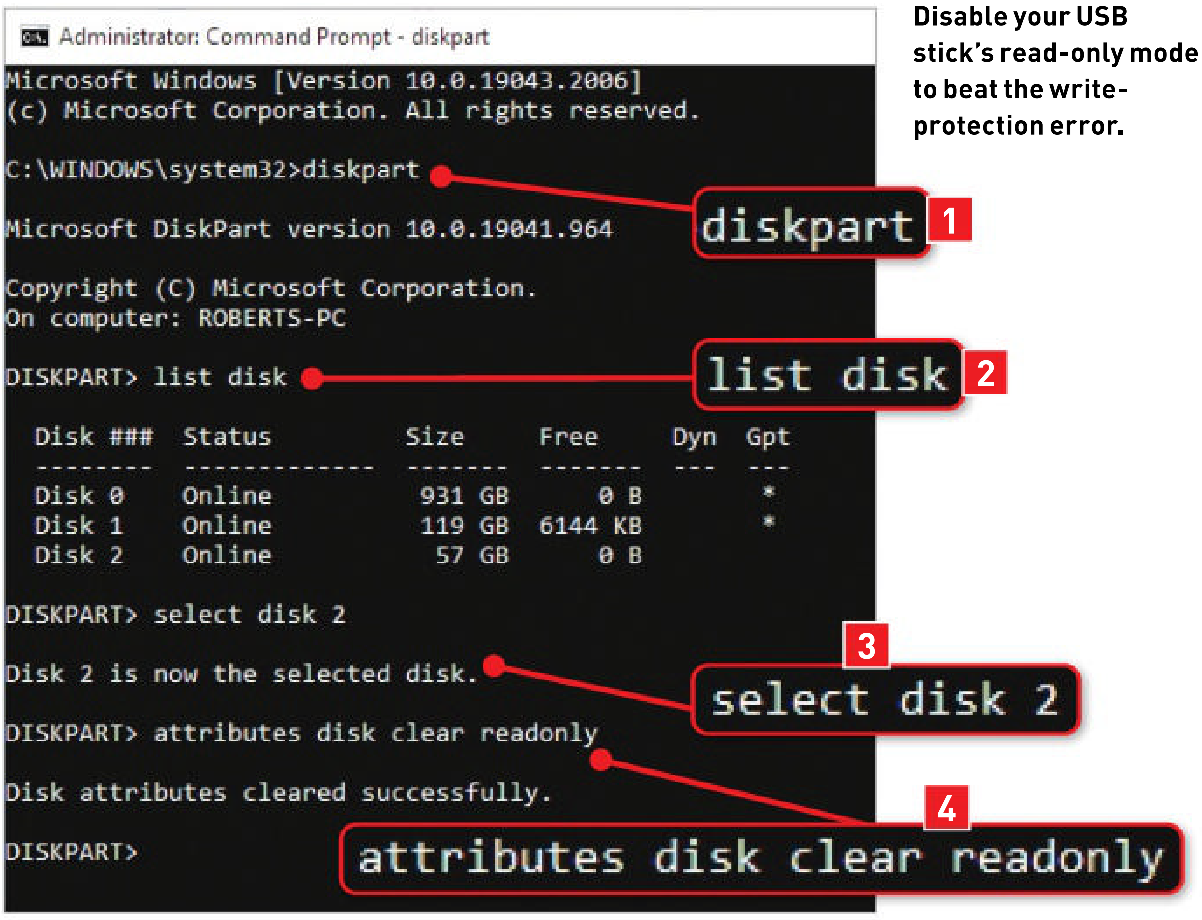
When you try to copy files to a USB stick, you may sometimes see the error message: 'This disk is write-protected. Remove the write protection or use another disk'. There are several potential causes of this problem, but it's usually possible to fix it relatively easily.

You should first check if a mechanical switch on the device is set to Write Only mode. This is designed to protect your data but also stops you from transferring anymore, so turn it off temporarily before copying files.

Next, right-click your USB stick in the This PC section of File Explorer, choose Properties and, on the General tab, make sure there's enough free space for new files. Also click the Security tab and, in the 'Permissions for everyone' section, ensure there's a tick next to Write in the Allow column. If not, click Edit and tick the box there.

If everything looks as it should, try removing write protection by disabling 'read-only mode' in Command Prompt. Type `cmd` in the Windows search box and click 'Run as administrator' under Command Prompt.

When Command Prompt opens, type `diskpart` (1 in our screenshot) and press Enter, then `list disk` 2 and press Enter again. This will list all the disk drives currently connected to your computer. Note the number of your USB stick and type `select disk` followed by that number, for example, `select disk 2` 3. Press Enter, type `attributes disk clear readonly` 4 and press Enter again. This should disable your USB stick's read-only settings, allowing you to copy files to the drive. As a last resort, you can format the USB stick to make it usable again, but this will wipe all the data currently stored on it—see the box on page 45 for more advice on formatting.


Administrator: Command Prompt - diskpart
diskpart 1
list disk 2
3 select disk 2
4 attributes disk clear readonly

```
Microsoft Windows [Version 10.0.19043.2006]
(c) Microsoft Corporation. All rights reserved.

C:\WINDOWS\system32>diskpart

Microsoft DiskPart version 10.0.19041.964

Copyright (C) Microsoft Corporation.
On computer: ROBERTS-PC

DISKPART> list disk

  Disk ###  Status         Size     Free     Dyn  Gpt
  --------  -------------  -------  -------  ---  ---
  Disk 0    Online          931 GB      0 B        *
  Disk 1    Online          119 GB  6144 KB        *
  Disk 2    Online           57 GB      0 B

DISKPART> select disk 2

Disk 2 is now the selected disk.

DISKPART> attributes disk clear readonly

Disk attributes cleared successfully.

DISKPART>
```

Disable your USB stick's read-only mode to beat the write-protection error.

techradar.

ORGANIZE YOUR STICKS TO FIND FILES FASTER

Change the drive letters of your USB sticks

When you plug a USB stick into your computer, Windows assigns it the next available drive letter. This means you can never be sure which letter a stick will have, which is a problem if you want to perform automatic backups to a specific drive. To resolve this, you can set your own drive letters, which Windows will remember the next time you insert a USB stick.

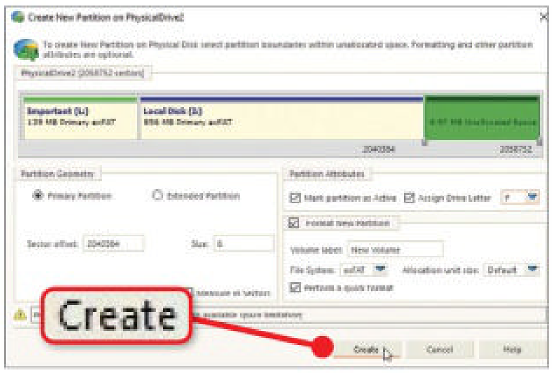
You can change drive letters through the Disk Management feature in Windows, but a better option is to use DriveLetterView from NirSoft. This free tool has the advantage of listing USB sticks that aren't currently inserted in your PC, allowing you to easily set their drive letters, or delete them if you no longer use that device.

Download the program from www.nirsoft.net/utils/drive_letter_view.html and extract the contents of the ZIP file. Right-click the 'DriverLetterView.exe' file and choose 'Run as administrator'. In the list of drives that appears, right-click a USB stick, select Change Drive Letter and enter your preferred drive letter (**1** in our screenshot on the opposite page), then click OK to confirm. To reclaim a letter from an unused USB stick, select it and click the Delete button on the toolbar **2**.

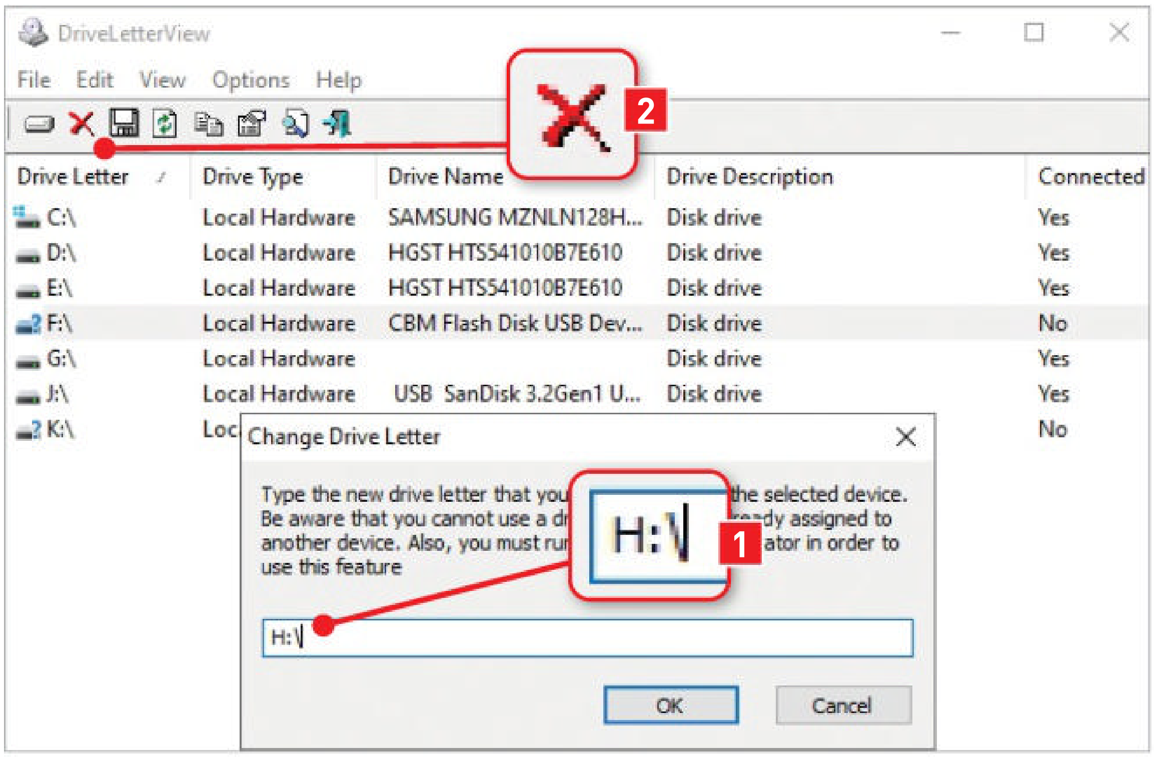
Create partitions on your USB stick

The more files you save to your USB stick, the harder it becomes to locate specific items. Although you can tidy things up by sorting files into themed folders, such as Photos, Videos, and Software, the best way is to divide your stick into partitions.

This allows you to devote one partition to a bootable operating system, use another for portable software, create an encrypted vault for sensitive files, and store random items loose in another partition. You can make partitions in the appropriate sizes, format them using different file systems, and delete them without affecting the rest of the drive.



Divide your USB stick into partitions and store different types of files in each one.



Drive Letter	Drive Type	Drive Name	Drive Description	Connected
C:\	Local Hardware	SAMSUNG MZNLN128H...	Disk drive	Yes
D:\	Local Hardware	HGST HTS541010B7E610	Disk drive	Yes
E:\	Local Hardware	HGST HTS541010B7E610	Disk drive	Yes
F:\	Local Hardware	CBM Flash Disk USB Dev...	Disk drive	No
G:\	Local Hardware		Disk drive	Yes
J:\	Local Hardware	USB SanDisk 3.2Gen1 U...	Disk drive	Yes
K:\	Loc			No

Type the new drive letter that you … the selected device.
Be aware that you cannot use a dr… ready assigned to
another device. Also, you must ru… ator in order to
use this feature

H:\

Use DriveLetterView to change the drive letters of your USB sticks.

Rather than use the slow Disk Management tool in Windows, download the free program Active@ Partition Manager (www.pcdisk.com). This makes it easy to partition your USB stick, by selecting unallocated space on the drive and choosing Create New Partition. If there isn't any unallocated space, you'll need to delete the current partition, so save any files stored on it first.

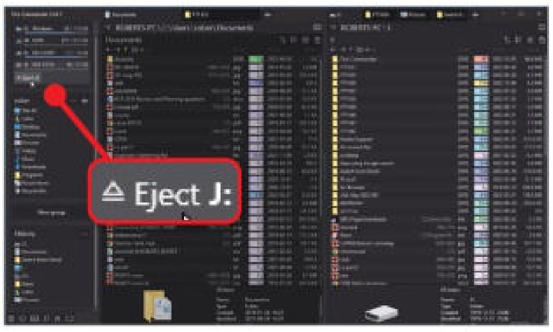
Set a size for the new partition, mark it as Active, and assign it a drive letter, then choose which file system to format it with. Click 'Create' (see below left) to add the new partition to your USB stick, then repeat the steps to create further partitions. Give each partition a distinctive name by selecting it, choosing Change Attributes, and entering a name in the Volume Label box.

When you open File Explorer, you'll now see separate drive letters for each partition on your USB stick, which you can use to store whatever files you want.

Copy and manage files more easily

Although you can use File Explorer to manage the contents of your USB stick, it can be slow and prone to freezing when browsing folders and searching for files. Thankfully, there are plenty of alternative file managers, which you can run from your USB drive to find, access, and copy items more quickly.

One of the best is One Commander (www.onecommander.com), which is free for home use and has a portable version that is ideal for managing USB sticks. Download the ZIP file, extract its contents to your stick, and double-click the 'OneCommander.exe' file.



One Commander is a feature-packed tool for managing files on your USB stick.

When One Commander opens, you can use its dual-pane interface to have your hard drive displayed on the left and your USB stick on the right (or vice versa). This lets you quickly move files from one to the other by dragging and dropping them—hold down Ctrl to copy items instead.

Click the plus button at the top of either pane to open new tabs, so you can browse the contents of sub-folders simultaneously. Other useful features include a summary of available space on all your drives, an option to safely eject your USB stick with a single click (see above), a 'History' list of folders you've opened recently, a preview window for images and videos, and a fast, accurate search tool—click the magnifying glass icon in the bottom left to open this.

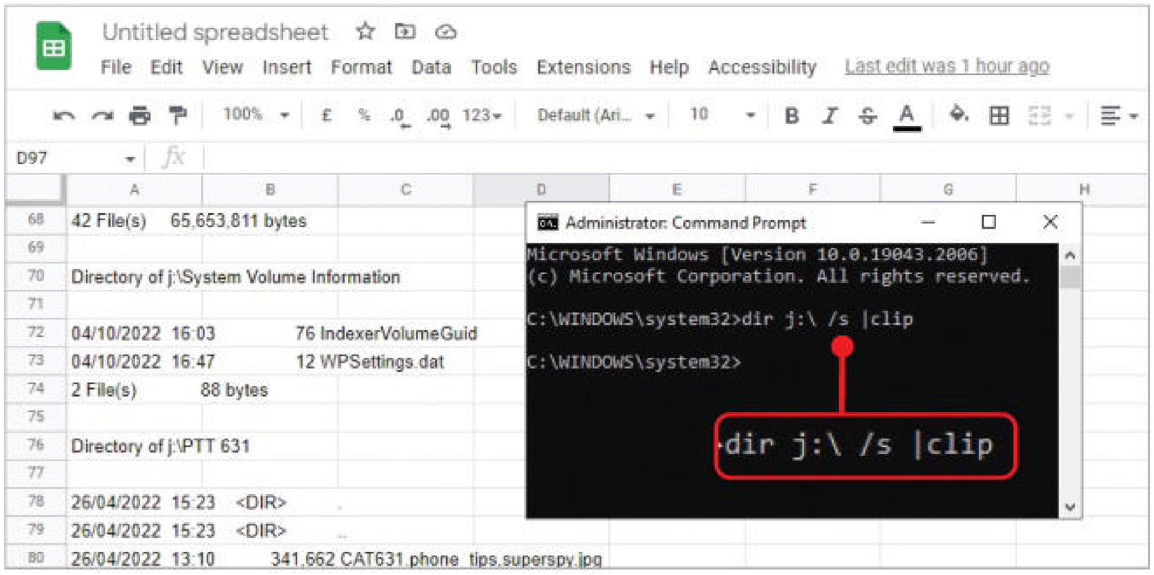
Create a printable list of a stick's contents

It's handy to keep a record of all the files and folders that are stored on your USB sticks, so you know where to find them

© DRIVELETTERVIEW, ONE COMMANDER

and in case a device is lost or corrupted. You can create an inventory of the contents of a removable drive by entering a simple command in Command Prompt. Type `cmd` in the Windows search box and click 'Run as administrator' under Command Prompt. When Command Prompt opens, type `dir j:\ /s |clip` (see right) but replace 'j' with the drive letter of your USB stick—copy this command from our Pastebin account (pastebin.com/LFCARmY3) then tweak it accordingly—and press Enter.

Next, open a new document in a spreadsheet program such as Excel, Google Sheets, or LibreOffice Calc, and click Edit then Paste, or press Ctrl+V. A list of all the files stored on your USB stick, including in subfolders, which is what the 's' refers to in the command, will be pasted into the document. This includes details of each item's name, the date and time it was last modified, and the total size of each subfolder. Save a copy of this inventory to your computer and print a hard copy for future reference.


Untitled spreadsheet
File Edit View Insert Format Data Tools Extensions Help Accessibility
Last edit was 1 hour ago
100% £ % .0 .00 123 Default (Ari... 10 B I S A
D97
A B C D E F G H
Administrator: Command Prompt

	A
68	42 File(s) 65,653,811 bytes
69	
70	Directory of j:\System Volume Information
71	
72	04/10/2022 16:03 76 IndexerVolumeGuid
73	04/10/2022 16:47 12 WPSettings.dat
74	2 File(s) 88 bytes
75	
76	Directory of j:\PTT 631
77	
78	26/04/2022 15:23 <DIR> .
79	26/04/2022 15:23 <DIR> ..
80	26/04/2022 13:10 341,662 CAT631 phone tips.superspy.jpg

```
Microsoft Windows [Version 10.0.19043.2006]
(c) Microsoft Corporation. All rights reserved.

C:\WINDOWS\system32>dir j:\ /s |clip

C:\WINDOWS\system32>
```

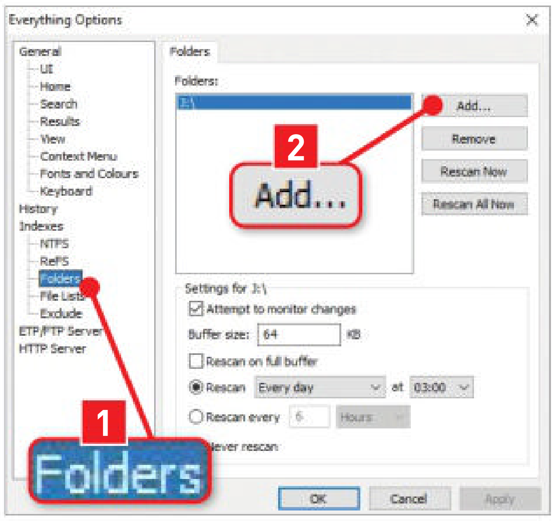
`dir j:\ /s |clip`

Use this simple Command Prompt trick to create an inventory of your USB sticks.

Find files faster on your USB stick

You can use Windows' built-in Search tool to index the contents of a USB stick and include it in search results, but the option is disabled by default. To turn it on, type `indexing options` into the Windows search box and click the 'Best match'. When the Indexing Options box opens, click Modify and select your USB stick in the list of locations. Click 'OK' then Close and Windows will index files and folders on your stick to make them easier to find.

Windows Search is notoriously slow so you may prefer to use the free search tool Everything (www.voidtools.com). Download and install the program or run the portable version, then click the Tools menu and click Options. Choose 'Folders' in the Indexes list (**1** in our screenshot right), click the Add button **2** and select your USB stick. Click 'OK' then Apply and Everything will index your stick's contents so it's included in future searches. Click 'Rescan Now' to speed up the process.


Everything Options
General
UI
Home
Search
Results
View
Context Menu
Fonts and Colours
Keyboard
History
Indexes
NTFS
ReFS
Folders
File Lists
Exclude
ETP/FTP Server
HTTP Server
Folders
Add...
Remove
Rescan Now
Rescan All Now
OK
Cancel
Apply
1
Folders
2
Add...

Folders: J:\

Settings for J:\

☑ Attempt to monitor changes

Buffer size: 64 KB

☐ Rescan on full buffer

● Rescan Every day at 03:00

○ Rescan every 6 Hours

○ Never rescan

Add your USB stick to Everything to find files faster than using Windows Search.

Best USB sticks you can buy now

BEST FOR CAPACITY

Kingston DataTraveler Max 1TB

$199 www.tinyurl.com/55d5jek6

With a 1TB capacity and an ultra-fast USB 3.2 (Type-C) connector, the Kingston DataTraveler Max's incredible storage and speed make it more like an SSD than a standard USB stick. It includes a keyring loop, blue status light, and retractable cover. Cheaper 256GB and 512GB models are available for $45 and $67 respectively.

BEST FOR VALUE

Verbatim Pinstripe

From $9 www.tinyurl.com/5fpppcyp

What it lacks in looks, the Verbatim Pinstripe more than makes up for in value, and it's the cheapest USB stick available when it comes to price per gigabyte. Even the 64GB model costs less than $25. For a few extra dollars, you can buy the USB 3.0 version, which offers even faster data transfer speeds.

BEST FOR SECURITY

Apricorn Aegis Secure Key 3NX

From $62 www.tinyurl.com/yc33db3r

Although it's pretty expensive, with the 128GB model priced at $175, Apricorn's USB 3.0 stick is a reliably secure choice if you regularly carry around sensitive files. It has a physical keypad, so you can lock and unlock it using a personal PIN, it protects your data using 256-bit AES encryption, and it's dust- and waterproof.

© KINGSTON, VERBATIM, APRICORN

ENCRYPT STICKS AND ERASE OLD FILES

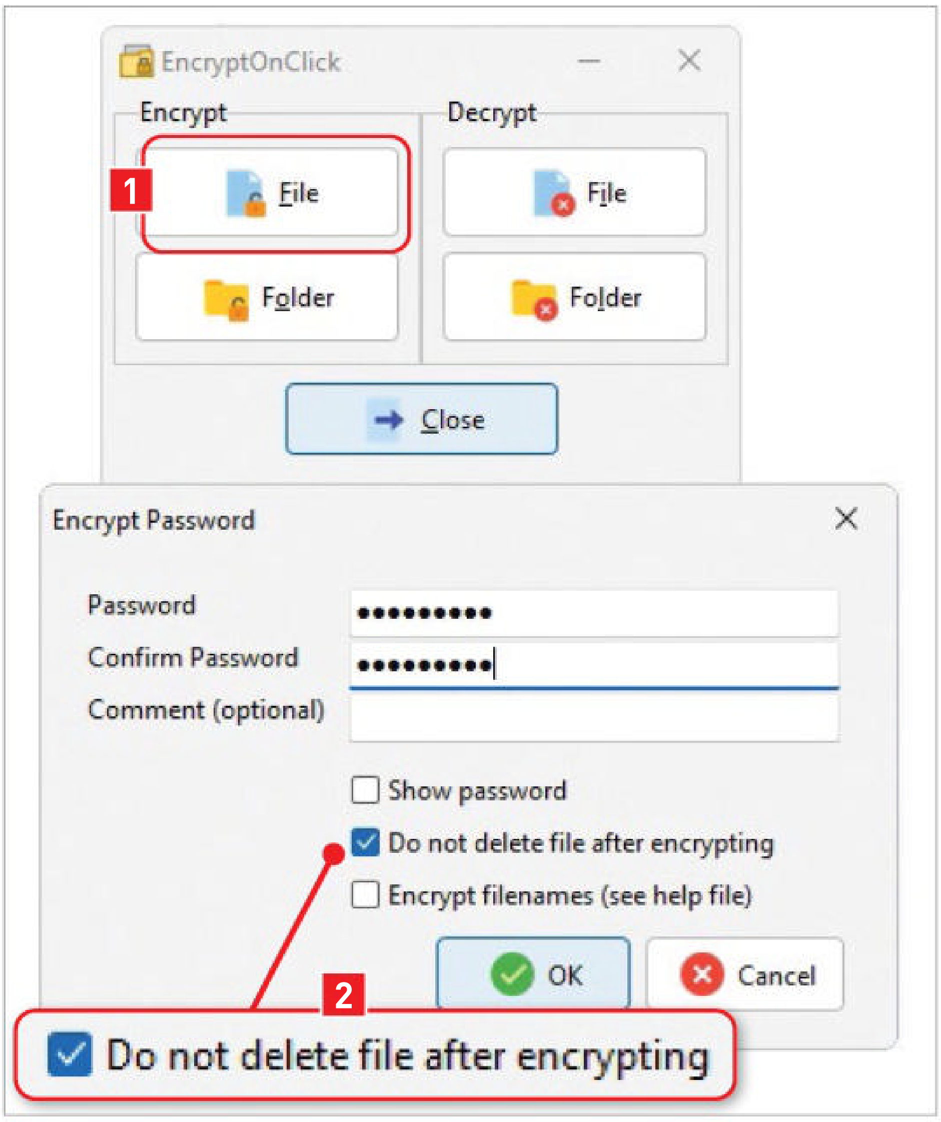
Encrypt specific files on a USB stick

If you're only saving one sensitive file to a USB stick, such as a private video or a document that contains financial information, you don't need to encrypt the whole drive. Instead, you can use the free tool EncryptOnClick (www.tinyurl.com/3t65yk27) to encrypt and decrypt the file in question.

With your USB stick inserted, run EncryptOnClick and click File in the Encrypt section (**1** screenshot right). Find and select the file you want to encrypt (this can be on the USB stick or your PC) and enter a password to protect the item. By default, the program will delete the original, unencrypted version, leaving only the encrypted copy, but you can tick 'Do not delete file after encrypting' **2** to stop this happening.

Click 'OK' to encrypt the file—the name won't change, but it will gain a '.EOC' extension and a padlocked folder icon. To decrypt the file, simply double-click it and enter your password or choose File in the Decrypt section of EncryptOnClick. The original item will now appear and the encrypted version will be deleted.

To access the encrypted file on your USB stick using a different computer, you'll need to install EncryptOnClick on that PC or on the stick itself.



Password ●●●●●●●●●
Confirm Password ●●●●●●●●●
Comment (optional)

☐ Show password
☑ Do not delete file after encrypting
☐ Encrypt filenames (see help file)

☑ Do not delete file after encrypting

EncryptOnClick can encrypt sensitive files on your USB stick.

Turn your stick into an encrypted vault

You can safeguard the contents of your USB stick against loss, theft, and unauthorized access by turning the device, or a partition on it, into a password-protected, encrypted vault. The best free program for this purpose is VeraCrypt (www.veracrypt.fr/en). Although it isn't the easiest tool to use, it offers powerful security features.

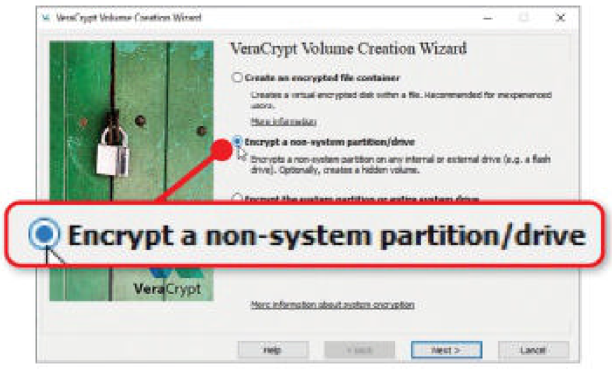
Download the VeraCrypt EXE Installer (www.veracrypt.fr/en/Downloads.html), install and run the program, and click Create Volume. Choose 'Encrypt a non-system partition/drive' (see screenshot below), then 'Standard VeraCrypt volume' and Select Device. Select your USB stick in the list (or one of the partitions on it), and click OK then Next. If the stick or partition is empty, or you don't mind losing the files on it, select 'Create an encrypted volume and format it'. If not, select 'Encrypt partition in place' to retain the files. Leave the encryption options at their defaults, enter a password to protect your device, and move your mouse around randomly to increase the encryption strength. Click 'Format' or Encrypt (depending on whether you're wiping the stick), then Yes. VeraCrypt will now encrypt the drive.

Select a drive letter for your encrypted vault and choose Mount. Enter your password and your USB stick or partition will appear as a normal drive in File Explorer. Make sure you click Dismount before removing the device from your PC.

Securely erase an old USB stick

Performing a full format of a USB stick will wipe and overwrite all the data stored on it. However, there's still a possibility that deleted files can be restored using a commercial data-recovery tool. To securely erase an old USB stick, download Disk Wipe from www.diskwipe.org/download.php—the system requirements only mention Windows XP and Vista, but it works perfectly well in Windows 10 and 11 and with FAT32 (including exFAT) and NTFS drives. Select your USB stick in the list of System Local Disks and click the Wipe Disk button in the top-left corner.

Click 'Next' on the File System screen, then choose how many times you want to overwrite the data on your stick, from one 'pass' to 35 passes. Click 'Next' then type `ERASE ALL` in the box (see screenshot above) and click Finish to wipe your USB drive. ⏻

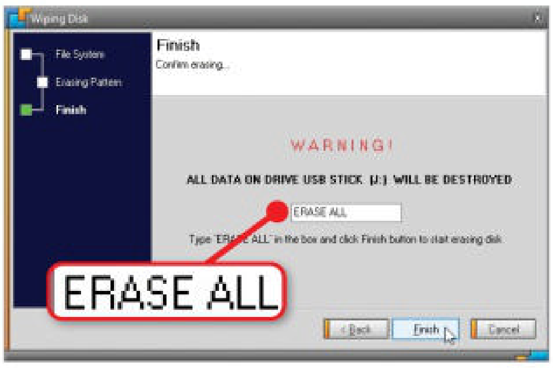

VeraCrypt Volume Creation Wizard
VeraCrypt Volume Creation Wizard
VeraCrypt
Help
< Back
Next >
Cancel

○ Create an encrypted file container

● Encrypt a non-system partition/drive

● Encrypt a non-system partition/drive

VeraCrypt lets you encrypt your whole USB stick or one of its partitions.



WARNING!

ALL DATA ON DRIVE USB STICK (J:) WILL BE DESTROYED

ERASE ALL

Type "ERASE ALL" in the box and click Finish button to start erasing disk

ERASE ALL

DiskWipe securely overwrites data on an old USB stick several times.

© ENCRYPTONCLICK, VERACRYPT, DISKWIPE

CE FOLD

Samsung Odyssey Neo G8

SAMSUNG'S Neo G9 is almost as known for its glitchy mini-LED backlight and buggy image processing as it is for its 49-inch proportions and 1000R curve. So, this latest iteration of the smaller Neo G8 comes with plenty of baggage.

It's just 32 inches in diagonal and runs a conventional 4K pixel grid, however, things get much fancier. The refresh rate is 240Hz, currently as good as it gets at 4K. Then there's the mini-LED backlight and its 1,196 zones and crazy 2,000 nits peak brightness. Throw in quantum dot tech, 1ms response times, an RGB lighting system, and lots of glossy white plastic and you have a stellar overall proposition.

We're not sure about that 1000R panel curve. On a super-size ultrawide panel like the G9, it makes sense but we're not convinced it adds anything here. As for the experience, the new G8 serves up, some of the same mini-LED-derived weirdness the G9 suffers is also present on this smaller panel. Pity. –**JEREMY LAIRD**

1 GET CONNECTED

Given the context is 4K and 240Hz, connectivity is critical. Fortunately, the Neo G8 sports both DisplayPort 1.4 and HDMI 2.1. The latter supports display stream compression, allowing the full 240Hz over HDMI. What you don't get, however, is USB-C. Drat!

2 BRIGHT LIGHTS

The Neo G8 rocks a mini-LED backlight with no fewer than 1,196 dimming zones. That only works out to about one zone for every 6,500 pixels, which makes for pretty approximate lighting and requires algorithms that have to make obvious tradeoffs.

3 SPEED FREAK

If the mini-LED backlight disappoints, the G8 delivers when it comes to speed—240Hz is an outrageous refresh rate for a 4K panel. What's more, the 1ms response means the Neo G8 is as quick as it gets for LCD monitors. Only OLED panels can better that.

CHOOSE YOUR VR ADVENTURE

Whether you're looking for a room-scale VR headset or an all-in-one solution without the need for a PC, *Louise Blain* looks at three of the best options on the market now

META QUEST PRO

MUCH HAS BEEN said about Mark Zuckerberg's reveal of the Meta Quest Pro at the most recent Meta Connect event. The concept of legs coming to the metaverse was talked about more than the headset itself, and we're going to go out on an, er, limb here and say that the tech world wasn't particularly surprised when it turned out Zuckerberg's lower half had actually been motion captured. It all muddies the water around an exceptionally powerful device that demands clarity. The stylish $1,500 Meta Quest Pro is not a VR headset. This is an MR or mixed reality set of goggles. And that means there are some key differences to think about if you just want a gaming device.

The Meta Quest Pro has been designed specifically for mixed reality experiences. So where the majority of VR headsets go to great pains to eradicate even a glimpse of the outside world, the Quest Pro has been purposefully designed with gaps at the sides of the headset so you can see the outside world.

Combined with the color pass-through from the high-resolution front cameras, this is designed to give you a seamless mixed reality experience and make you feel like you're truly interacting with a digital version of the real world. There will be an optional add-on for use with VR games but this is a clear indicator of what the headset is specifically designed for and the kind of experiences Meta wants you to have. Think design work and collaboration rather than zombie killing in *The Walking Dead: Saints and Sinners*.

In both design and sheer power, the Quest Pro considerably outstrips the Quest 2. The battery sits on the back of the plastic strap instead of a part of the headset itself, which makes for a more comfortable fit, and there's now a Snapdragon XR2+ processor with 12GB of RAM. There's a massive upgrade in visual fidelity too. The Quest Pro also makes the most of ultra-bright mini-LED LCD panels which, as we have seen on new TVs over the past couple of years, offers a considerable upgrade in contrast and detail too. Add in a standard storage of 256GB over the Quest 2's 128GB and this is a beast of a headset.

But that's not the only upgrade for this headset. The Quest Pro officially has more sensors than you'll know what to do with. A camera replaces the outer loop on the controllers for finger positioning, you can add a stylus for more accurate design work, and Meta has followed Sony with eye-tracking technology inside the headset. It also has face tracking to mirror your expressions and recreate them in the digital world. That might not be ideal for gaming but Meta's aim of globally collaborating on work projects means that smiles may matter. Just don't ask Meta whether or not you'll have legs.

STRENGTHS / WEAKNESSES

⊞ COLOUR PASSTHROUGH ⊞ INWARD FACING SENSORS
⊞ BACKWARD COMPATIBLE

⊟ VERY EXPENSIVE ⊟ META ECOSYSTEM
⊟ DESIGNED FOR MIXED REALITY

PICO 4

WHEN THE STANDALONE Quest headset arrived in 2019, it felt like the future of virtual reality for gaming. Immersive room tracking VR with no need for a PC? Wireless everything... what wizardry was this? Well, it's wizardry that other manufacturers have been keeping a close eye on. PICO is a VR subsidiary of ByteDance, the owners of TikTok, and has potentially just released a brand new, standalone Quest killer. With no Quest 3 in 2022 as might have been expected, the $425 PICO 4 is more than happy to fill the gently rounded VR headset-shaped gap. This is a device with its fully RGB-supported camera lenses set on the crown of Meta's prized all-in-one. And with a sea of upgrades, it's an impressive headset.

The PICO 4 is geared toward comfort and accessibility with a focus on gaming and fitness. That price point is competitive but this isn't a headset that's skimping on functionality. Its topline stats are excellent—there are 2160x2160 pixels per eye, an enviable 105° field of view, and it boasts a Qualcomm Snapdragon XR2 chipset like the Quest 2 but with 8GB of RAM compared to the Quest's 6GB.

And the slick futuristic design isn't just easy on the eyes but on our necks too. What PICO calls its Pancake Optics system means that the lenses aren't as heavy and, without the strap, the goggles themselves only weigh 295g. The placement of the battery on the rear of the headband means less strain overall, thanks to a less concentrated center of gravity, which is ideal for long boxing sessions in FitXR. There's no guarantee it will prevent those ski goggle-style dents in your skin though.

4K resolution comes as standard on the display and the PICO 4 has a welcome, innovative approach to interpupillary distance, or IPD. Put simply, IPD is the setting that brings everything into crisp focus as we match the VR headset lenses to the distance between our eyes. Where the Quest 2 has just three manual settings, the PICO 4 lets you set anywhere between 62-72mm within the headset settings menu. This means no cranking a dial or having to take the headset off to get just the right level of focus for your eyes.

In even more useful news, the passthrough camera has full RGB so you can see the world around you in full technicolor, unlike the fuzzy black and white of the Quest 2. This will be ideal for full mixed reality apps, which PICO says it has on the way. And the controllers with haptic vibrations are pretty neat too. Interestingly, the plastic loop is on the inside of your hand rather than the outside and turned toward your wrist, keeping it protected. This means you are less likely to smash them into one another in the heat of battle as you desperately reload.

Add in a battery life of two to three hours and Steam VR compatibility via streaming, which alleviates any concerns about the PICO VR Store being smaller than Meta's, and the PICO 4 is an exceptional all-round headset at a great price. It's the perfect way to get your head in the game without breaking the bank.

STRENGTHS / WEAKNESSES

+ GAMING AND FITNESS STANDALONE + BATTERY WEIGHTED TO THE REAR + CAN STREAM STEAM VR

− NO 120HZ REFRESH RATE − LIMITED GAME LIBRARY − PART OF THE TIKTOK ECOSYSTEM

VALVE INDEX

THE NEW BREED of virtual reality headsets are mostly focused on an experience that you can tidy away once you've done your *Beat Saber* for the day. But what if you want to immerse yourself in room-scale VR games? The Valve Index, released in 2019, is still one of the most impressive headsets on the market. Its style is somewhat more brutalist and functional than the new generation but that's because Valve understands that you won't care what it looks like when you're wearing it. VR gaming isn't about looking like you're in your own lifestyle ad.

However, the bar for entry for the Index is significantly higher than for most headsets. Access to Steam's selection of virtual reality offerings isn't just a matter of handing over $1,800 for the headset, base stations, and controllers, but also clearing a room and investing in a gaming PC powerful enough to deliver the visuals the Index is capable of.

But once you've got your room ready, powered each base station, and plugged in all three cables into your beast of a gaming PC, nothing looks or feels like the Valve Index as you disappear into VR. As you'd expect from the gaming leviathans, everything has been engineered for sheer immersion. The Index has dual LCD screens with 1440x1600 pixels per eye, exceptional clarity and brightness, and a 120Hz refresh rate. And, if your PC can take it, there's even a 144Hz experimental mode for your eyes to feel even more intimidatingly immersed in the whopping 130° field of view. Gone are the tunnels of old-school VR headsets—the Index makes you feel like you've been literally dropped into a virtual world.

And Valve won't be outdone on controllers. The Index Controllers work like hands, with 87 sensors to determine hand and finger positioning, motion, and pressure. Every movement of your digits is expertly tracked so you don't feel like you're holding controllers and instead can use your hands naturally to grip, feel and interact with the environment. This is especially impressive the first time you load up *Half-Life: Alyx*—a game that comes free with the Valve Index. Interacting with this world by touching, prodding, and grabbing feels like the VR future we were promised.

Where other VR headsets rely on the triggers of what are effectively standard pads, the Valve controllers can be squeezed to grip things. Because they are effectively worn instead of held, these natural interactions mean VR universes become more inviting, avoiding the need for spending hours with white knuckles. Add the base stations for full motion tracking and the Index still delivers the most natural VR experience. However, the setup to get there isn't as smooth as squeezing a trigger in *Half-Life: Alyx*.

STRENGTHS / WEAKNESSES

⊞ EXCEPTIONAL CONTROLLERS ⊞ ROOM-SCALE VR ⊞ INCREDIBLE FOV

⊟ YOU'LL NEED A POWERFUL GAMING PC ⊟ STILL TETHERED ⊟ REQUIRES BASE STATIONS

AI doesn't just make stuff up—it's also helping us to understand the past better. **Lee Grant** explains how...

The AI that's remaking history

RARELY DOES a month pass without a new AI system hitting the news, with the tech labeled as forward-looking, autonomous, and poised to improve our futures. What we don't often hear about is the increasing utilization of AI to examine our pasts.

Historians, archaeologists, musicians, and data scientists are deploying AI technologies to re-imagine and re-create historical moments. We'll explore the immense human challenges in getting the best results from AI machines, and, as you'll discover, there's no magic-bullet computing at work.

Like so many tales from the evolution of modern computing, success with AI is grounded in the values of collaboration, opportunity, and experimentation. The challenges our experts face require distinct technical solutions while sharing striking amounts of commonality.

We'll look at the bias and ethics of restorative AI and consider how we should interpret and categorize such works. We'll also consider a timeline of AI, stopping at points between the modern day and the ancient world, hearing from people who have used AI to expand our perspective of historical events, enhance familiar sights and sounds, and even rewrite the history books. AI is already changing our perceptions of the past. Welcome to reality.

Filling in the gaps

Jonathan Prag is a professor of ancient history at Oxford University in the United Kingdom and has always had a passion for computing. "I got into mapping and visual analysis, which led to trying to build a digital catalog of all the inscriptions from ancient Sicily," he says.

AI helped Dr. Gino Caspari to identify ancient structures.

Prag is an epigraphist, specializing in the restoration of ancient Greek texts carved into stone. Over the centuries, many carvings have been smashed into fragments, some of which have never been recovered, leaving vast gaps between words. In 2018, Prag's PhD student Thea Sommerschield and Google DeepMind's Yannis Assaelto suggested using AI to speed up the laborious process of filling the gaps in ancient texts. "I just sat there and said, that's cool! Can you do it?"

A successful AI project relies on high-quality source data to "learn", and Prag's team didn't have any. "In the 1980s, Hewlett-Packard mobilized scholars to type up the published Greek inscriptions," he said. "It's horribly messy and because it went from beta code into Unicode at a certain point, it's full of artifacts."

AI was used to speed up the laborious process of filling the gaps in ancient texts

Sommerschield painstakingly cleaned the data to give the team more than 100,000 texts, from which the team trained Pythia, its first AI machine, which could hypothesize the missing words from the Greek texts. However, Pythia's successor was already in development. "Ithaca pays attention to patterns in the text, with references about the region that each text came from, and the proposed date," said Prag.

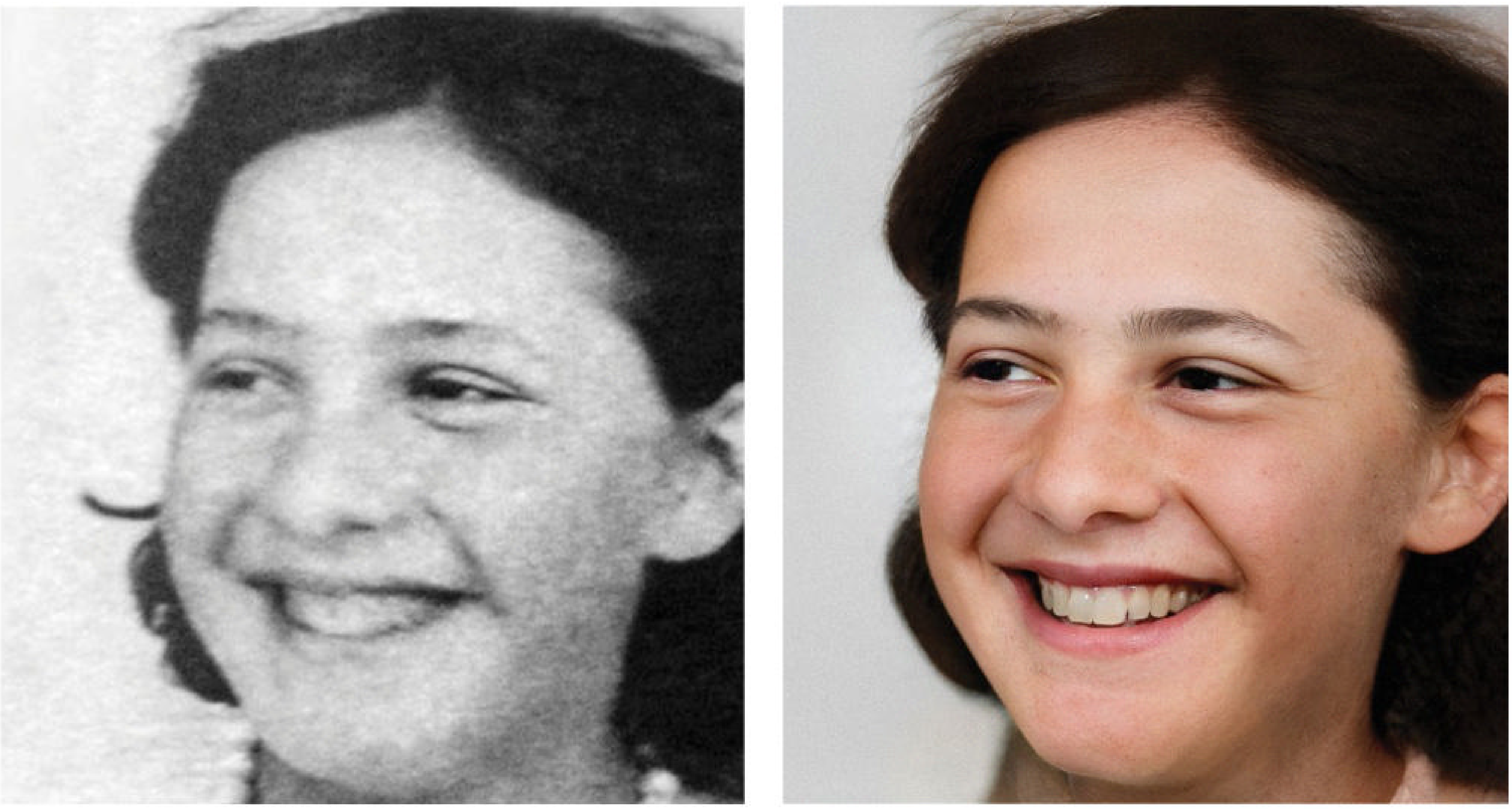
The Ithaca machine (ithaca.deepmind.com) has already resolved a point of conjecture in Athenian texts regarding the Greek letter S (or sigma). "The state abandoned the three-bar form of sigma, which enabled you to put a bunch of texts on one side or the other of 445BC," said Prag.

This date marker had been considered gospel within historical scholarship, but the few dissenting voices must have cheered when Ithaca was let loose on the data. "We ran Ithaca over the original data and it came out with new dates, moving them down by about 30 years." This shift alters the interpretation of a key period of Athenian imperialism. "It makes a big difference to our reading of this famous bit of Greek history," says Prag.

Dr. Gino Caspari, from the University of Sydney in Australia, is an archaeologist with a passion for things so old that they make Ancient Greece seem positively modern. He's studied the burial mounds of the Scythians, an ancient tribe of nomadic warriors who lived in parts

Dr Smola and Emil Wallner trained AI on Gustav Klimt's work.

© T WALLACE, GOOGLE ARTS/CULTURE LAB PARIS



Old images are sharpened and colorized by neural.love.

It's important to remember that, despite the dystopian headlines, AI is simply a customisable tool

of Asia more than 3,000 years ago. With his colleagues, Dr. Caspari built a convolutional neural network (CNN) using satellite imagery to identify circular structures, seeking lost Scythian tombs. "Arriving in the survey area a year later, I immediately saw how wrong I had been," he says. "What I had assumed to be buried structures, in fact stemmed from the locals corralling sheep in circular fenced areas."

Dr. Caspari's long journey to see someone else's lambs was because of poor data fuelling the AI. "The limitation is the availability of high-resolution satellite data, which is too expensive for archaeological projects to afford," he says.

His recent work on tracking 3,000-year-old Native American settlements in the US south was completed with the commercial package, ArcGIS (arcgis.com). "In archaeology, we are clearly not at the forefront of development in AI and the number of people actively working on AI is limited," he said. "To find broader adoption, we will ultimately need a kind of intuitive GUI that allows you to train models without coding."

It's important to remember that, despite the dystopian headlines, AI is simply a customizable tool. Dr. Caspari combined AI, LiDAR images, and multispectral data to find more settlements, including many situated further north than had ever been documented. Could this have been achieved without AI? "Yes, but it would have taken a lot longer," he says. "Due to small training data sets, we often have a high number of false positive detections and those still need to be weeded out by hand. We are not really reaching superhuman performance in most cases due to a lack of training data."

Making movies

Let's leave the ancient world and travel to 1888 and the garden of Oakwood Grange in Leeds, UK. Louis Le Prince, the "Father of Cinematography", is using his invention, the motion-picture camera, to film the Whitely family. Today, only 20 grainy frames remain of what is acknowledged to be the oldest surviving film in existence, but this didn't stop Denis Shiryaev from using AI to create something rather marvelous. "I've always been the history junkie, and I decided to apply my knowledge of artificial intelligence," he says.

Using the images posted on the London Science Museum website, Shiryaev re-animated the stills, applying a CNN to add detail to the faces and upscale the resolution. In total, the AI-generated 250 colorized and stable frames. "I am a creator for my own audience," said Shiryaev. "AI colorization is not real, and it's not historically accurate. I generate faces based on old source photos or paintings, it's also an approximation. It's important to have this small disclaimer that this video is AI."

Shiryaev's use of AI is not to establish historical accuracy, but to inject verisimilitude into old footage, refreshing it for a modern audience. Almost 65 million YouTube views of his channel underlines his success and the interest in these types of works. "I saw this popularity as an opportunity," he said. "Some companies from Hollywood, huge brand names, contacted me."

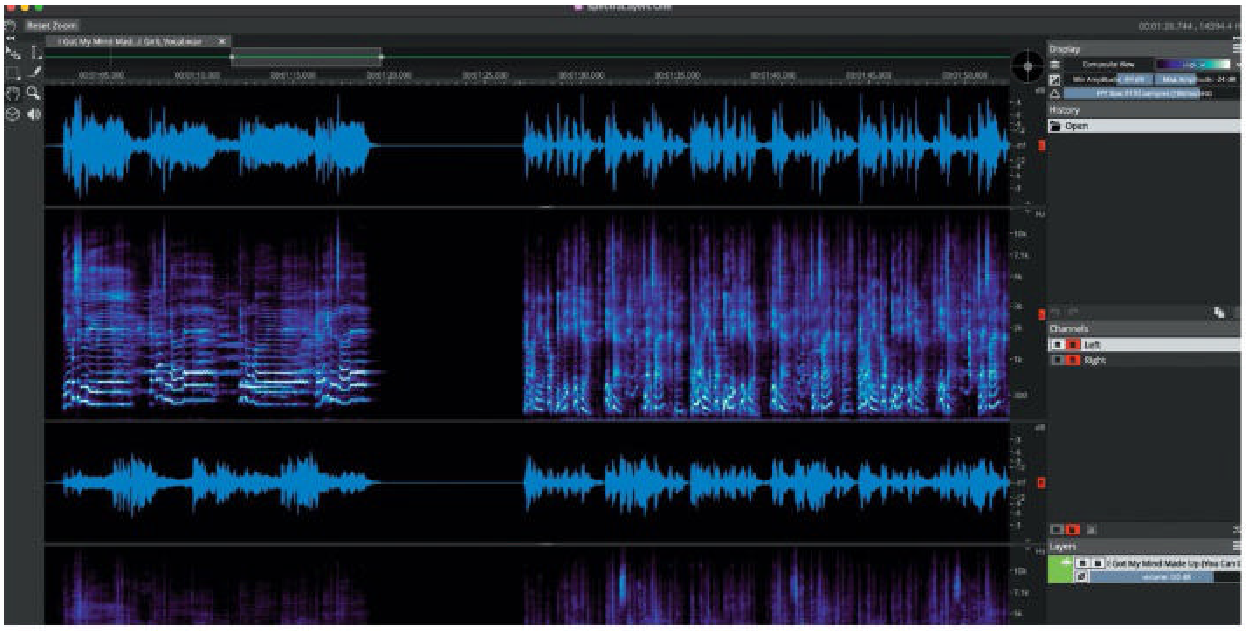
In 2020, Shiryaev launched neural.love (neural.love), an automatic cloud-based AI service that makes media enhancement accessible to anyone. "We have this beautiful feature called Generate Portfolio," he says. "You can upload old low-resolution photos and generate high-quality portraits from them. People love it."

There is a dedicated team to help deliver neural.love's automated tool to customers. "We're developing and building AI, in a responsible way," says Shiryaev. When we train our neural networks, we're creating tools for content creators, movie makers, bloggers, or people who have archives of old family photos."

Giving a non-technical user access to AI is a growth area, and competition is fierce. Audioshake (audioshake.ai) is an award-winning specialist in separating fully-mastered recordings back into their individual audio stems. "Stems are the different parts of a song, for example, the vocal or drum stem," explains the company's CEO, Jessica Powell. "We take the full recording and pull it apart."

Audioshake's clients are seeking the flexibility to re-purpose audio. "In advertising, the car is going around the bend and they want to increase the energy of the bass, or in a movie, Angelina Jolie walks on screen, and they turn down the a cappella on the Rolling Stones' song to make sure the audience is focused on what she's saying. You need the parts for all that."

Audioshake has produced an industry-leading AI, winning Sony's "Demixing challenge" by beating research institutions, private companies, and researchers from Facebook and TikTok. To win, Audioshake's AI produced a vocal stem that was a full decibel higher than any other competing team.



Audioshake separates music tracks into their component parts.

© AUDIOSHAKE

"When we started, we thought our customers were going to be from old recordings, where no stems were made. However, it's common for people to not have their stems and there can be a bunch of reasons for that," she says. "We had a customer come to us, one of the biggest producers in the world. Their hard drive had crashed and they had lost a couple of albums' worth of stems."

Powell is also clear on the key component required for AI success: human experts. "Certain kinds of recordings need different things. What time period is it from? What genre is it? That requires a level of human curation in terms of deciding what you're doing and deciding the places where your AI is still falling short. In my mind, that is an incredibly human thing."

Stripping back songs

A popular use of AI within the music industry is to enhance old recordings by removing noise and artifacts, often present since the day they were captured. In May 1972, singer Mary Hopkin performed at London's Royal Festival Hall and a venue engineer captured her sublime performance. By 2005, the technical quality of the recording needed some assistance, as Mary's son Morgan Visconti explains. "It was probably done hastily on a quarter-inch tape. The noise flow is heavy, and it gets worse as you got towards the end of the gig; there's more noise than signal."

Visconti is a musician and producer with a passion for technology. "I was chatting with my mom about noise removal and suggested she let me have a go—it was stunning. Just to hear it without the noise, it felt like a refresh, like you cleaned your ears out to hear the nuances. She was pleased with it".

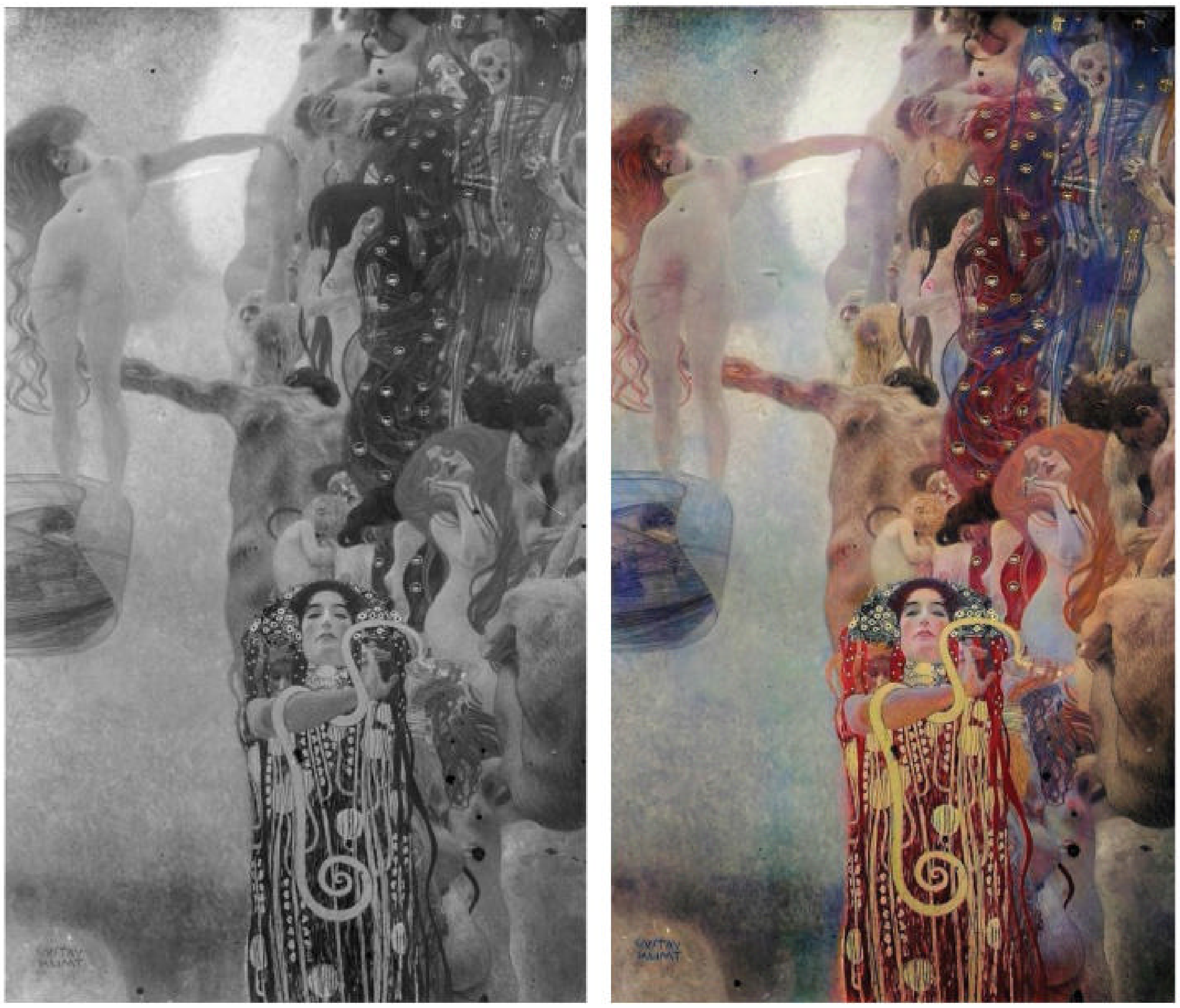
Once again, experimentation and passion honed Visconti's skills after he had a lightbulb moment with iZotope's mastering suite (izotope.com). "The music rebalance feature was an eye opener, or an ear opener," says Visconti. "The ability to go into a mixed track and make stems for bass, vocals, drums, guitars, and keyboards. It's something I dreamt about as a kid. I went nuts, I took everything apart like old Beatles recordings, and I was like, 'What can I do with this thing?'"

> We experiment with the cutting edge of technology and then find interesting areas we can apply it

Visconti sees AI as just another tool available to a music producer and, having grown up in music studios, he's seen them all. His father is the legendary music producer Tony Visconti, who asked Morgan to sprinkle this technical stardust over the soundtrack of *Moonage Daydream*, a recent film about rock superstar David Bowie. "The director used a ton of found footage and one clip is of Bowie playing *Rock 'n' Roll With Me* but the mix isn't great. Like the Festival Hall tape, this was recorded straight to mono. I was able to provide separated tracks of vocals, drums, keyboards, and bass, and Tony was able to remix the song for the film." *Moonage Daydream* went on general release in September 2022.

Experimental tech

AI remains experimental technology, even for the largest tech companies. Emil Wallner is part of Google's Arts & Culture lab. "We experiment with the cutting edge of technology and try to find interesting areas to apply



Google AI has added color to the work of Gustav Klimt.

What's clear in AI is that the 'A' is the computer and the 'I' is a human

it to," he says. "Sometimes it doesn't work and we don't publish things, sometimes we have interesting results and we share them."

More recently, the lab has experimented with the works of the world-renowned artist, Gustav Klimt. "We go to a lot of museums, to digitize collections so that anyone can access them online. At the Belvedere Museum in Vienna, the topic to start working with these Faculty Paintings came up."

Klimt's controversial Faculty Paintings, Philosophy, Medicine, and Jurisprudence, were destroyed by fire in 1945 and could only be viewed via a handful of old monochromatic photos. To give Google's AI some color training data, Dr. Franz Smola, curator at the Belvedere Museum and Klimt expert, stepped in. "Franz looked at what all the critics said about these paintings," says Wallner.

Dr. Smola scoured written records and gathered paintings by similar period artists to reference their palettes and paint types. His months of painstaking research took Wallner's team another six months to convert into usable machine data. "We'd enable it to add a few pixels and a few motifs that we knew the colors of. We added pixels in the machine learning model, and from there, it colorized the entire painting."

Wallner is clear that this extraordinary project is not a restoration, but a re-colorization owing to the lack of detail in the monochrome photos. "One area would be to re-create the pointillism," he said. "He used a lot of gold which you can't really see, so you need to somehow augment that in a 3D environment to capture the impression of the metallic elements in those paintings".

What's clear in AI is that the "A" is the computer and the "I" is a human, and together they are capable of creating beautiful things.

RIDDING AI OF HARMFUL BIAS

The UK's Arts and Humanities Research Council (AHRC) has launched the Enabling a Responsible AI Ecosystem program to challenge some of the ethical questions posed by AI. Samantha McGregor, head of AI and design at AHRC, explains why the work is important. "AI presents ethical challenges and biases that differ depending on factors, such as the data it is trained on, the team developing it, the settings it is applied in, and who is using it," she says. "The program has been designed to ensure that the development and application of AI is responsible, accountable, and ethical by default."

Matthew Guzdial, a professor at the University of Alberta, urges caution about the bias present in AI systems. "AI models are trained on data that captures the biases of the current moment and replicates those biases at scale. Not only harmful issues like racism and sexism, but biases in terms of composition, uses of color and textures, and so on. Ensuring this doesn't make it difficult to progress is an open problem."

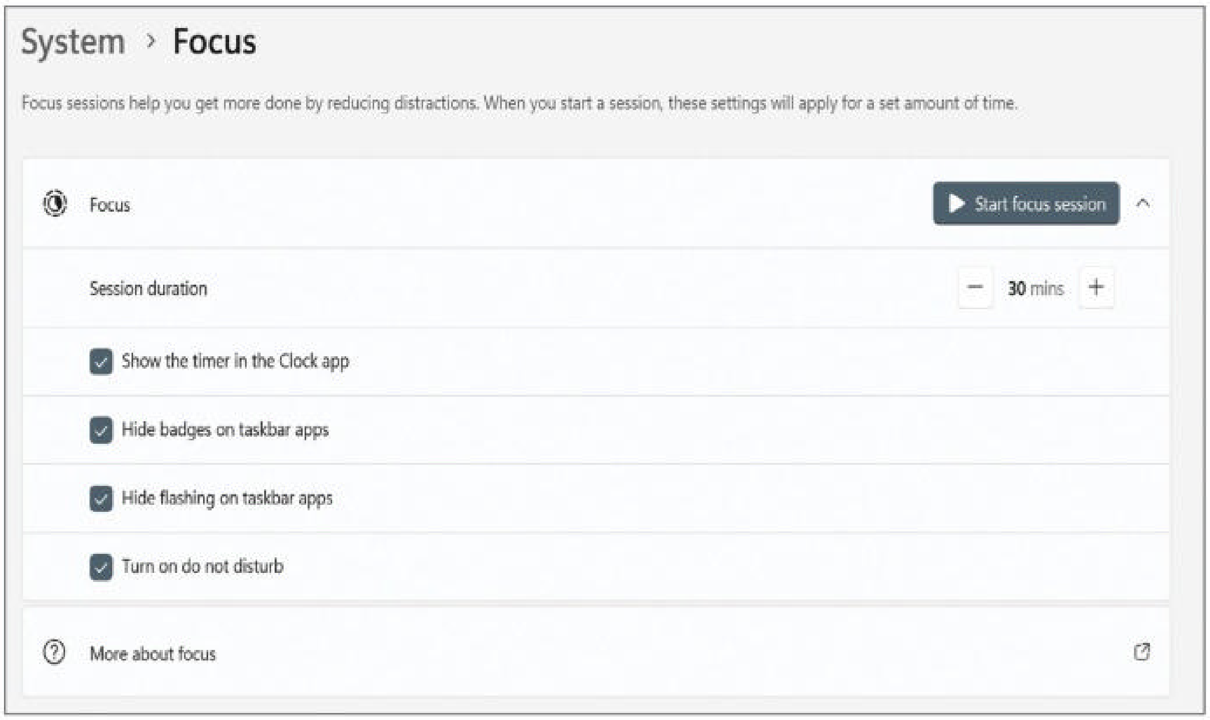
George King from the Ada Lovelace Institute believes long-standing ethics practices need to change. "AI examining human history raises exciting opportunities that researchers must learn to manage," he says. "In most corporate and academic institutions, research ethics committees (RECs) are insufficient for the challenges presented by AI. REC reviews are done before AI research, but the risks involved may only become apparent later in the cycle," he says. "Other risks can relate to engaging in extractive research practices in relation to indigenous communities, or unethical labor practices for third-party data labelers who clean the data to power AI systems. If AI research is to be done safely, such risks must be addressed and accounted for."

©IMAGE: MONOCHROME PHOTOGRAPHS HELD BY THE AUSTRIAN NATIONAL LIBRARY, RE-COLOURISED BY GOOGLE ARTS & CULTURE LABS AND THE BELVEDERE, VIENNA.

HOW TO

STEP-BY-STEP GUIDES TO IMPROVING YOUR PC

TIP OF THE MONTH



System › Focus

Focus sessions help you get more done by reducing distractions. When you start a session, these settings will apply for a set amount of time.

Focus — Start focus session

Session duration — 30 mins

☑ Show the timer in the Clock app

☑ Hide badges on taskbar apps

☑ Hide flashing on taskbar apps

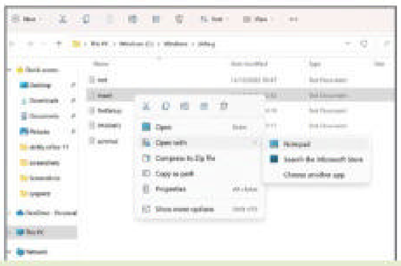
☑ Turn on do not disturb

More about focus

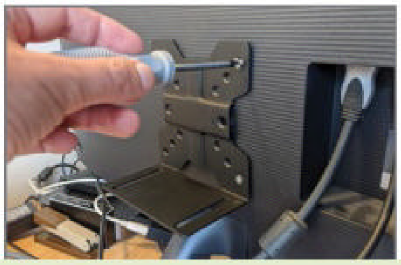
FOCUS

Are you five hours deep into an assignment and getting bombarded with Windows notifications that keep distracting you? We've certainly been in that situation ourselves, but to put some virtual tape over Windows OS's mouth, either search for Focus within the search bar, or go to settings, system, and then Focus. From here, you can fine-tune your notifications to receive only those you need to keep zoned into your work.

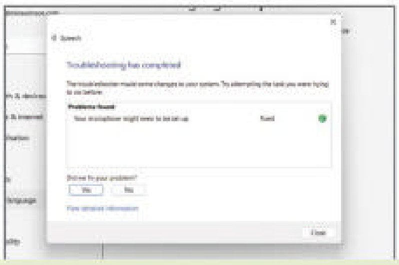
MAKE – USE – CREATE



62
Scan for malware your antivirus software misses.



68
Save desk space by mounting a mini PC to your TV.



70
Send hands-free emails, using only your voice.

© MICROSOFT

SAM LEWIS
STAFF WRITER

WI-FI WOES

What's fragile, incredibly frustrating, and lets you down? No, not the current economy, but my personal internet solution, an LTE modem. As usual, nothing ever goes as planned—when I moved into my new property, the Wi-Fi wasn't activated on the day it should have been live. My internet provider has been unreliable, but my contract runs out soon so I'm just going to ride it out. Anyway, this LTE modem is good for all of 30 minutes before it decides to go AFK on me and so I've finally gotten through to my provider after an hour or so on hold and arranged a new date for my connection to go live.

Those issues have given me plenty of time to set up my new workspace and I'm more than happy with it. I've got an L-shape desk with my PC sitting up top alongside my ultra-wide display. My main focus was to build a productivity space, which involved a ton of pre-planning and cable management. I have to say it looks pretty good and there's barely a cable in sight. One thing to take from my experience is to cable tie last. Believe me on that!

With my new setup, I've been able to test an RTX 4090. It's great, but comes with one major downside—I now need one of my own, naturally. That's the catch when you're lucky enough to be writing about the latest tech!

↘ submit your How To project idea to: editor@maximumpc.com

Scan for malware missed by antivirus

YOU'LL NEED THIS

MICROSOFT SAFETY SCANNER from https://learn.microsoft.com/en-us/microsoft-365/

IS YOUR COMPUTER MISBEHAVING? This isn't always a sign of something serious—a sluggish system might be caused by updates downloading in the background and a stuck cursor could be the result of the batteries in your mouse running flat. However, it could also be the result of malware, which is serious, because it might be performing unauthorized tasks in the background, such as feeding your activity back to a remote server controlled by hackers, or encrypting your files so it can demand a ransom to release them.

To combat threats like these, you should already be running the security tools built into the version of Windows you're using, which for 10 and 11 means Microsoft Defender Antivirus. These keep a look out for—and guard against—new and evolving threats by regularly downloading updates from Microsoft, which they use to monitor your system.

Here, however, we're going one step further by supplementing Defender Antivirus with Microsoft Safety Scanner. This is a separate program that you can use as a fallback when you can't launch or update Defender, or when they are reporting a clean system but you want a second opinion. –NIK RAWLINSON

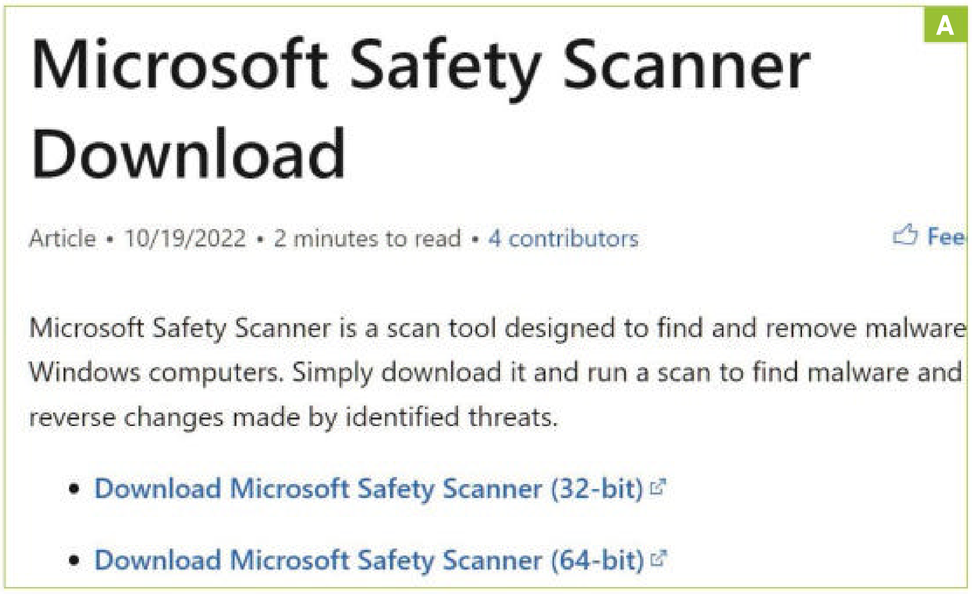
1 DOWNLOAD MICROSOFT SAFETY SCANNER

Download Microsoft Safety Scanner from https://learn.microsoft.com/en-us/microsoft-365/, where you'll find links for both 32bit and 64bit versions [**Image A**]. Your computer is more likely to be 64bit, but check by opening Settings (press Windows key+I), [**Image B**] then clicking System and About.

» Check the line beside 'System type' in the top section of the page that opens. As you can see from our screenshot, our computer is running a '64bit operating system'. Therefore, we'll click this link to 'Download Microsoft Safety Scanner (64-bit)'.

» You should download a fresh version of Microsoft Safety Scanner each time you want to use it. You should never use one that someone else has shared with you, and we wouldn't even recommend running the edition you downloaded the day before unless, for some reason, you're unable to download a new one. That's because Safety Scanner contains the latest virus definitions you need to look for while scanning.

» Microsoft updates Safety Scanner several times every day. So, if new threats have been identified since you last downloaded it and incorporated into the latest version, you won't be able to scan for them. For this reason, Microsoft has programmed Safety Scanner in such a way that the virus and malware definitions included within it will expire 10 days after being downloaded, at which point you'll need to download an update.



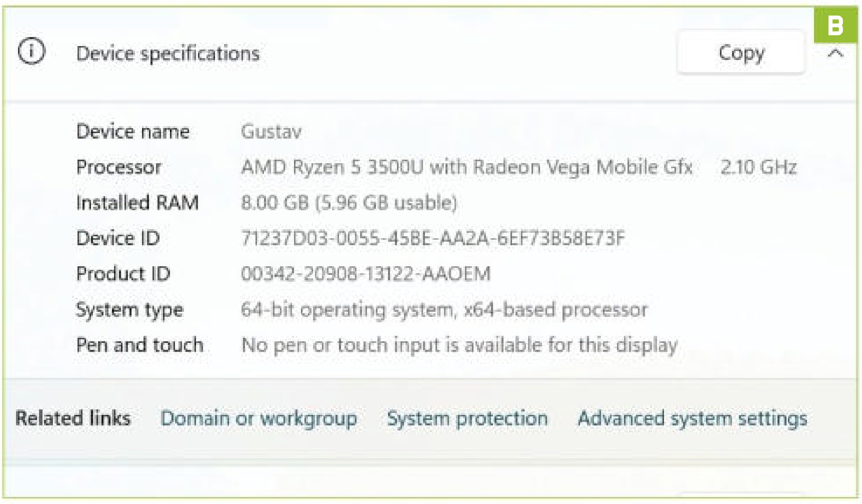
Microsoft Safety Scanner Download

Article • 10/19/2022 • 2 minutes to read • 4 contributors

Microsoft Safety Scanner is a scan tool designed to find and remove malware Windows computers. Simply download it and run a scan to find malware and reverse changes made by identified threats.

- Download Microsoft Safety Scanner (32-bit)
- Download Microsoft Safety Scanner (64-bit)

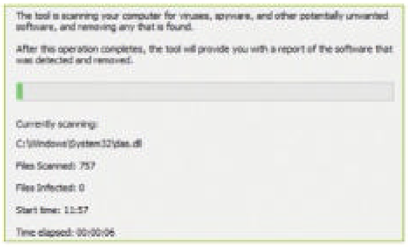
» You can download 32bit or 64bit versions of Microsoft Safety Scanner.



Device specifications

Device name Gustav
Processor AMD Ryzen 5 3500U with Radeon Vega Mobile Gfx 2.10 GHz
Installed RAM 8.00 GB (5.96 GB usable)
Device ID 71237D03-0055-45BE-AA2A-6EF73B58E73F
Product ID 00342-20908-13122-AAOEM
System type 64-bit operating system, x64-based processor
Pen and touch No pen or touch input is available for this display

» Check whether you're running a 32bit or 64bit version of Windows.



The tool is scanning your computer for viruses, spyware, and other potentially unwanted software, and removing any that is found.

After this operation completes, the tool will provide you with a report of the software that was detected and removed.

Currently scanning:
C:\Windows\System32\das.dll
Files Scanned: 757
Files Infected: 0
Start time: 11:57
Time elapsed: 00:00:06

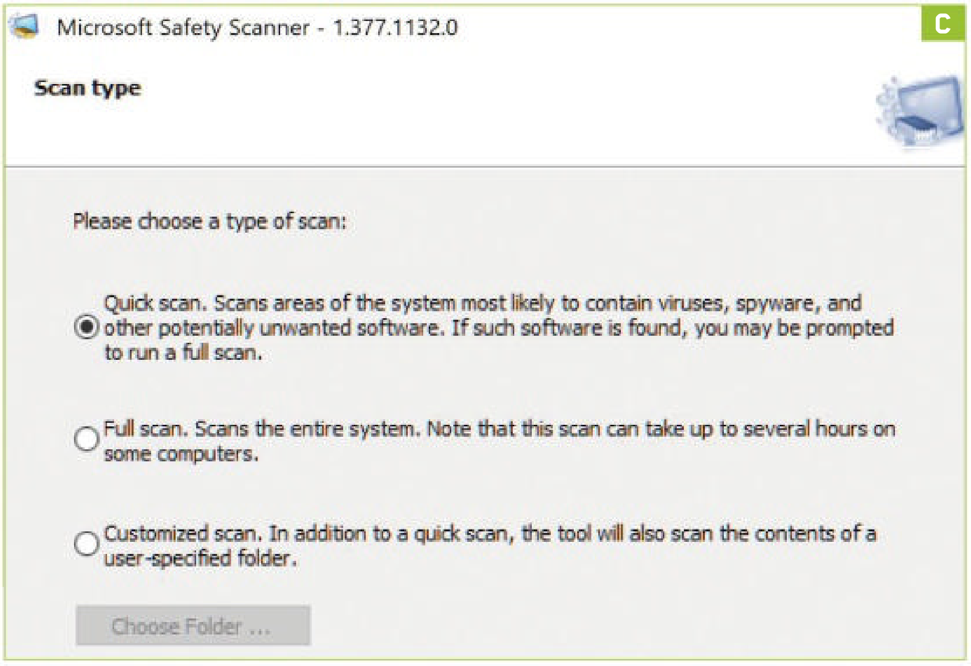
» You can work on your computer while the scan runs.

2 RUN MICROSOFT SAFETY SCANNER

Safety Scanner is a portable program, so it doesn't need to be installed before you can run it. Open your Downloads folder and double-click the 'MSERT.exe' file you've just downloaded. Windows will ask 'Do you want to allow this app to make changes to your device?'. Click Yes, tick the 'Accept all terms' box, then click Next twice.

» You now have three options, as shown in our screenshot. [**Image C**]. Quick scan targets the areas of your PC most likely to contain viruses, spyware, and other threats. This is likely to be adequate in many instances, and if anything suspicious is found it may ask you to run a full scan.

© MICROSOFT



Microsoft Safety Scanner - 1.377.1132.0

Scan type

Please choose a type of scan:

● Quick scan. Scans areas of the system most likely to contain viruses, spyware, and other potentially unwanted software. If such software is found, you may be prompted to run a full scan.

○ Full scan. Scans the entire system. Note that this scan can take up to several hours on some computers.

○ Customized scan. In addition to a quick scan, the tool will also scan the contents of a user-specified folder.

Choose Folder ...

» Leave the 'Quick scan' option selected then click Next.

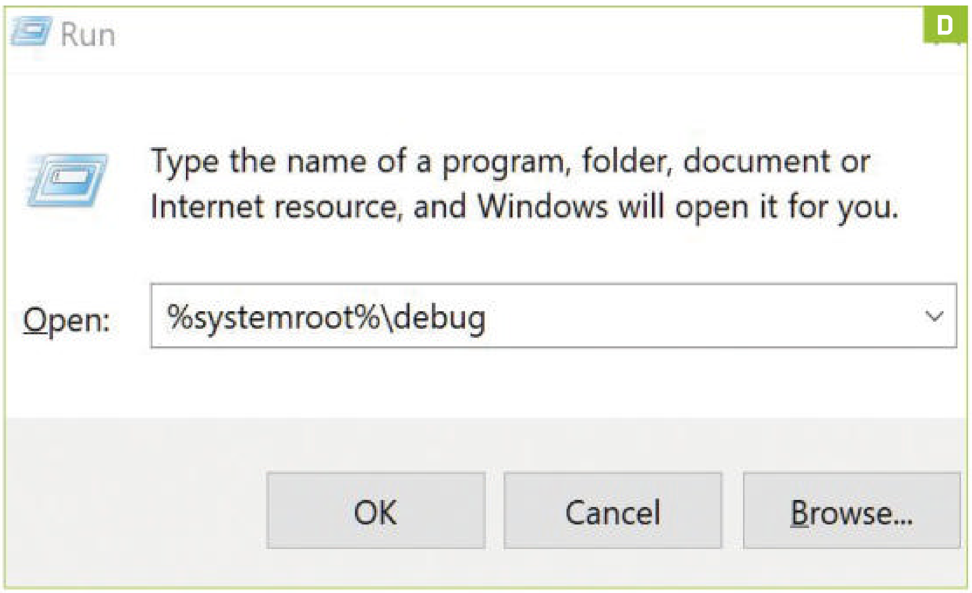
» Full scan examines all areas of your computer. This can take several hours to complete, depending on the size of your storage, the speed of your system, and its complexity, so it may be better to leave this running overnight, or at least at a time when you don't need to be using your computer intensively. Custom scan performs a quick scan and also scans the folders and subfolders that you've specified.

» Start with a quick scan by leaving this option selected and clicking Next. Safety Scanner will get to work, examining each folder and automatically removing infected files if it finds any.

» You can keep an eye on its progress or leave it unsupervised while you do something else. That could even be getting on with your work in another PC window because you don't need to stop using your computer while the scan runs.

» When it's finished, you will hopefully see a green shield and a message saying 'The scan completed successfully and no viruses, spyware, and other potentially unwanted software were detected'. However, Safety Scanner recommends asking the 'community' or submitting a support request if your problems continue. It's possible these are being caused by a threat that Microsoft has yet to add to Safety Scanner's virus definitions.

» The community in question is a security forum on Microsoft's website at https://answers.microsoft.com/en-us/ and the support link directs you to the general Microsoft Support pages at https://support.microsoft.com/. If you scroll down to the grey bar close to the bottom of that page marked 'More support options', you'll find a link to 'Contact us'.

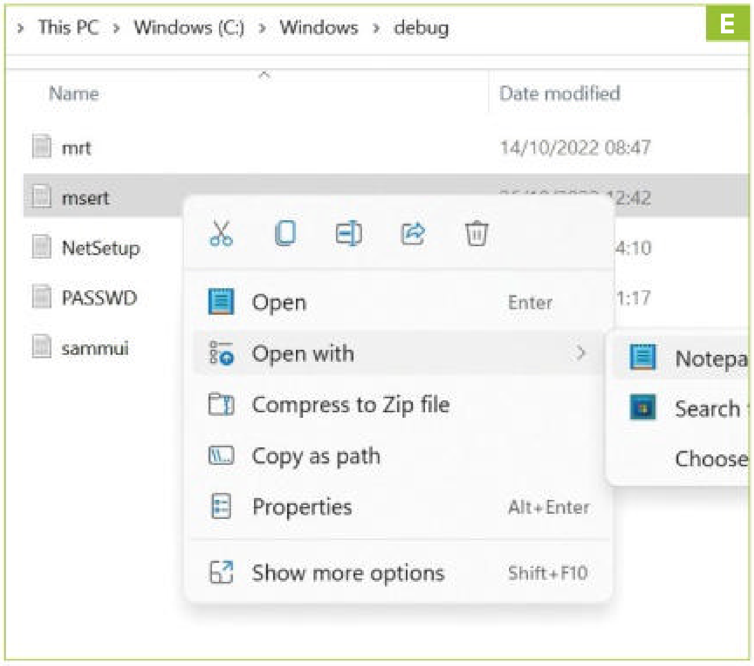

D
Run

Type the name of a program, folder, document or Internet resource, and Windows will open it for you.

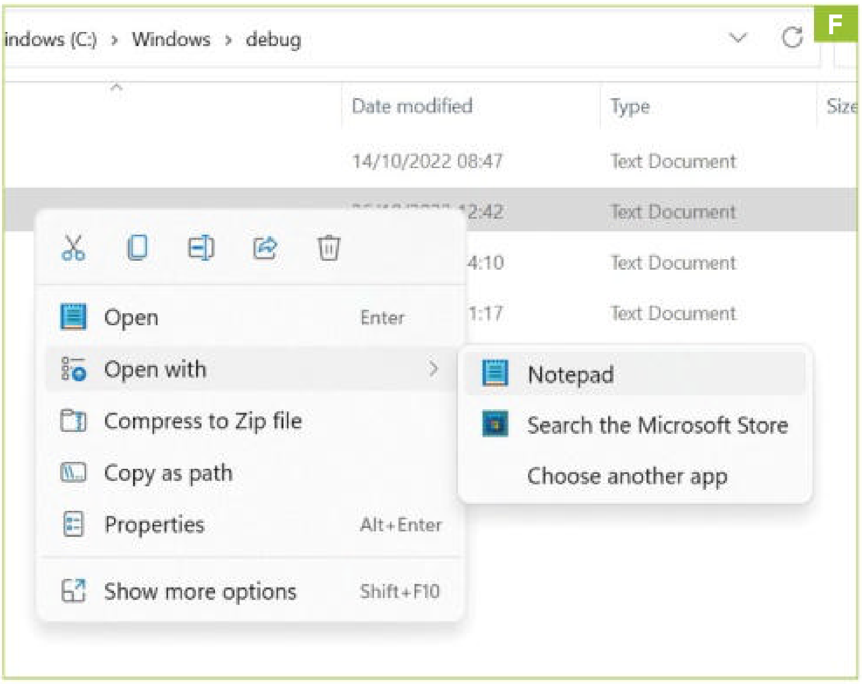
Open: %systemroot%\debug

OK
Cancel
Browse...

» Type this in the Run box to see what's in the Windows debug folder.


E
› This PC › Windows (C:) › Windows › debug
Name
Date modified
mrt
14/10/2022 08:47
msert
12:42
NetSetup
4:10
PASSWD
1:17
sammui
Open
Enter
Open with
Compress to Zip file
Copy as path
Properties
Alt+Enter
Show more options
Shift+F10
Notepa
Search
Choose

» Open debug files in Windows Notepad.


F
indows (C:) › Windows › debug
Date modified
Type
Size
14/10/2022 08:47
Text Document
12:42
Text Document
4:10
Text Document
1:17
Text Document
Open
Enter
Open with
Compress to Zip file
Copy as path
Properties
Alt+Enter
Show more options
Shift+F10
Notepad
Search the Microsoft Store
Choose another app

3

DIAGNOSE PROBLEMS FOUND BY SAFETY SCANNER

We had no trouble running Safety Scanner, which completed a quick scan of our system in less than 15 minutes and told us it was clean. However, if it does detect problems it will write an error code to a log file, which it saves to your hard drive. To open this, press the Windows + R to open Windows' Run box, and type `%systemroot%\debug` into the box [**Image D**].

» Press Enter and a new File Explorer window will open showing the contents of Windows' debug folder. This is where the operating system catalogs various processes that need to report what they've been up to.

» Look for a file called 'msert.txt' [**Image E**] (the '.txt' may be hidden, leaving just 'msert', depending on your setting. Right-click it, then hover your cursor over 'Open with' and click Notepad [**Image F**] .

» At the bottom of the file, you'll see a line starting 'Return code', with a value beside it in brackets. In our case, the value is '(0x0)'—as you can see in our screenshot—which indicates that the program ran and completed without any problems. However, a more extensive code will help you identify an error.

» Common return codes indicating errors include:

0x80508019
If the file or drive you asked it to scan doesn't exist.

0x80508024
If you need to run a full scan.
0x80508007
If it didn't have access to sufficient memory.

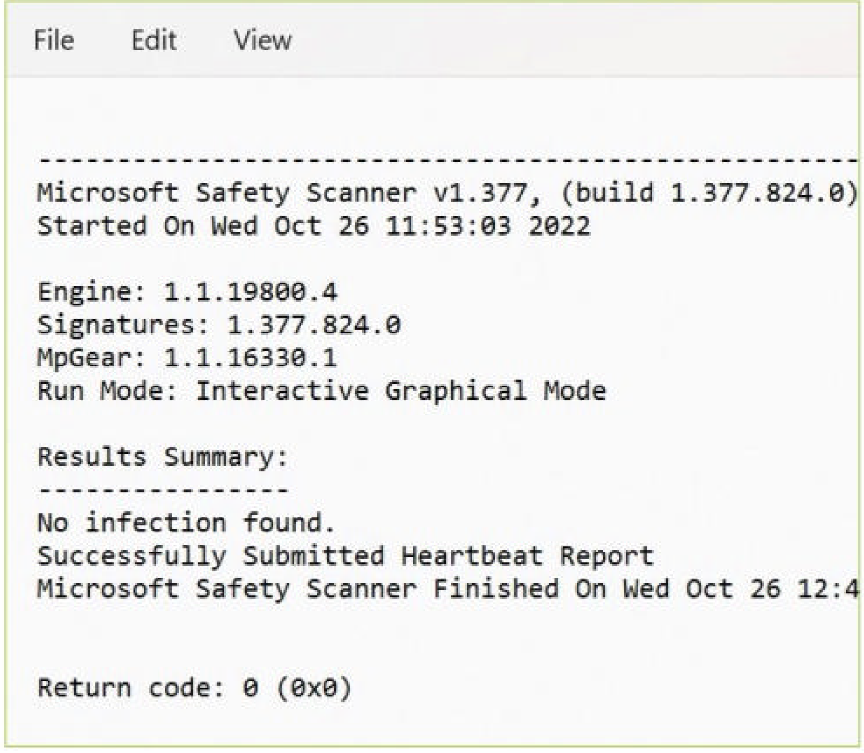
» You can find a full list of possible error codes and suggested remedies on Microsoft's support pages at https://tinyurl.com/2v637twh.

4 REMOVE MALWARE FROM YOUR COMPUTER

Safety Scanner will try to remove any malware that it finds. However, if it detects what it thinks might be malware inside an archive, commonly known as a ZIP file, you'll need to check it out yourself.

» Make a note of the file name that Safety Scanner has identified, then open Microsoft's threats 'encyclopedia' at https://www.microsoft.com/en-us/wdsi/threats, type the name into the 'Search encyclopedia' box at the top of the page, then press Enter. If you find one, remove the file from your system.

» To do this, press Windows key+R, then type the name of the file and press Enter. Windows will open a new File Explorer window showing its location. Right-click the file, then click Delete. You may be asked if you want to authorize changes to your computer before the deletion can go ahead. If so, click Yes.



```
-----------------------------------------------------
Microsoft Safety Scanner v1.377, (build 1.377.824.0)
Started On Wed Oct 26 11:53:03 2022

Engine: 1.1.19800.4
Signatures: 1.377.824.0
MpGear: 1.1.16330.1
Run Mode: Interactive Graphical Mode

Results Summary:
----------------
No infection found.
Successfully Submitted Heartbeat Report
Microsoft Safety Scanner Finished On Wed Oct 26 12:4


Return code: 0 (0x0)
```

» The 'Return code' is Safety Scanner's way of telling you what happened.

GET A SECOND OPINION—RUN ANOTHER SCAN

You shouldn't install multiple antivirus programs on your computer because they can interfere with one another. However, running several portable programs like Safety Scanner shouldn't be a problem because they won't be constantly keeping watch on what each other is up to. It's an effective way of getting a second opinion if you have doubts about the results delivered by Safety Scanner.

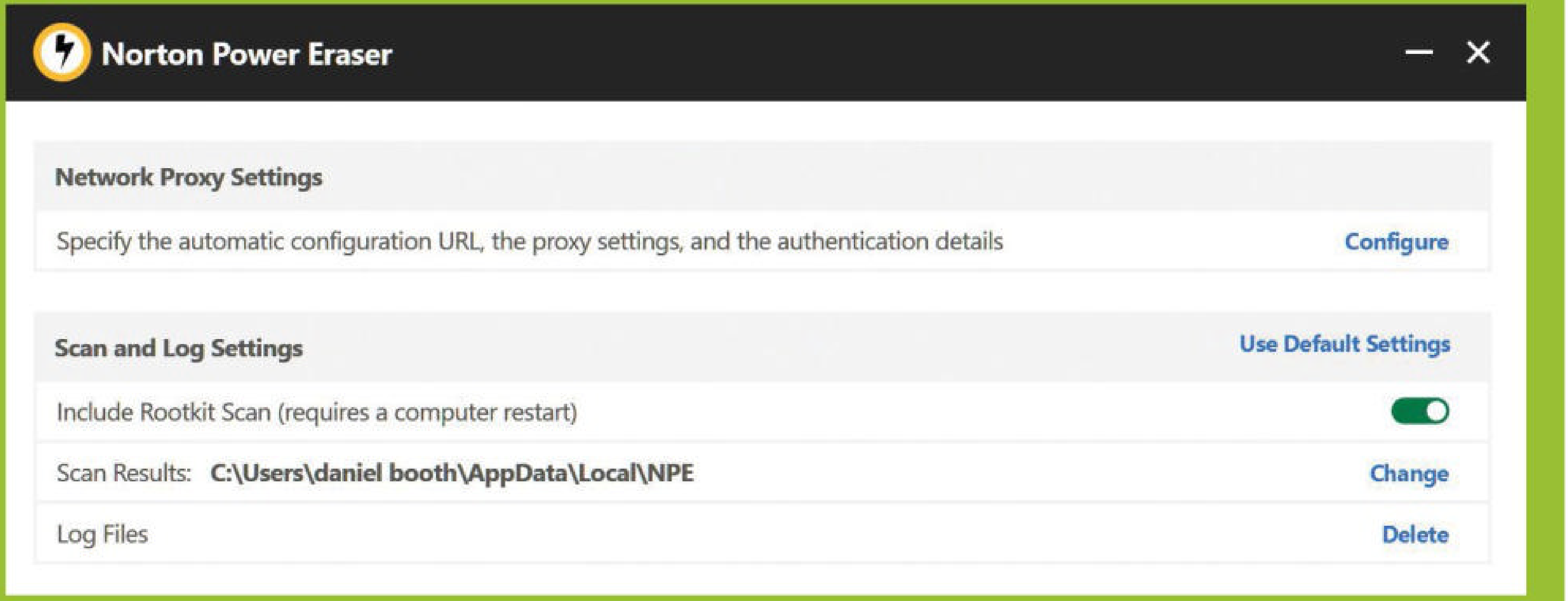
One recommended tool is Norton Power Eraser, which is also available in 32bit and 64bit versions (https://support.norton.com/sp/static/external/tools/npe). For Windows 10 and 11, select the 'Windows 7 SP1 or newer' option.

Launch the program from your Downloads folder, click Yes when asked if you're happy to make changes to your system, then decide what kind of scan you want to carry out. A 'Full System Scan' took less than two minutes on our test computer, with around 50GB on its hard drive. You can also scan specific files and folders, or look for unwanted software.

Once you have made your selection, click 'Run now' and wait for it to complete. Ideally, you want to see a No Threats Found banner at the end of the process but, if you get this and still suspect something is wrong, you can report it to Norton by clicking a link on the results screen.

If you dig into Power Eraser's settings by clicking the cog at the top right of the interface, you'll find an option to Include Rootkit Scan, which isn't enabled by default. A rootkit is a piece of malicious code that gives hackers unauthorized access to just about every function of your computer.

Click the slider to activate it (see screenshot), then click Apply, followed by 'Run now'. Power Eraser will warn you that it's going to reboot your computer. Save and close any other files, then allow it to reboot and, when it returns, click Yes to allow the program to make changes to your system. It now will run through the same process as it did for the quick scan but, additionally, check your system for rootkits.



Network Proxy Settings

Specify the automatic configuration URL, the proxy settings, and the authentication details

Scan and Log Settings

Include Rootkit Scan (requires a computer restart) ●

Scan Results: C:\Users\daniel booth\AppData\Local\NPE

Log Files

» Click the 'Include Rootkit Scan' slider to activate it, then click Apply.

© NORTON

GET READY TO BECOME A TRUE PYTHON EXPERT

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Beat power cuts and stay online

YOU'LL NEED THIS

UNINTERRUPTIBLE POWER SUPPLY (UPS)
Cellphone with hotspot feature
OPTIONAL: Router with SIM card support

WHILE POWER CUTS are still relatively rare for the majority of us in cities and towns, there are still lots of ways the power you take for granted could be interrupted or cut off. In many regions of the US, such as California, earthquakes can knock out the grid for days at a time, and while there are often signals they're about to happen, they can still strike with little warning.

There are also weather events such as storms and tornados that many areas deal with regularly and, of course, criminal damage to substations and other infrastructure. And there is always the potential for that most modern of activities, cybercrime, to threaten our critical online services. Indeed, cybercrime is predicted to remain on the rise over the coming years.

What we're saying is that it pays to have a backup plan when such events take place, so that at worst you don't lose any important data, and at best you can even carry on as normal if blackouts roll on for any length of time. Here's the equipment we recommend to protect yourself to beat power cuts and stay online. –NIK RAWLINSON

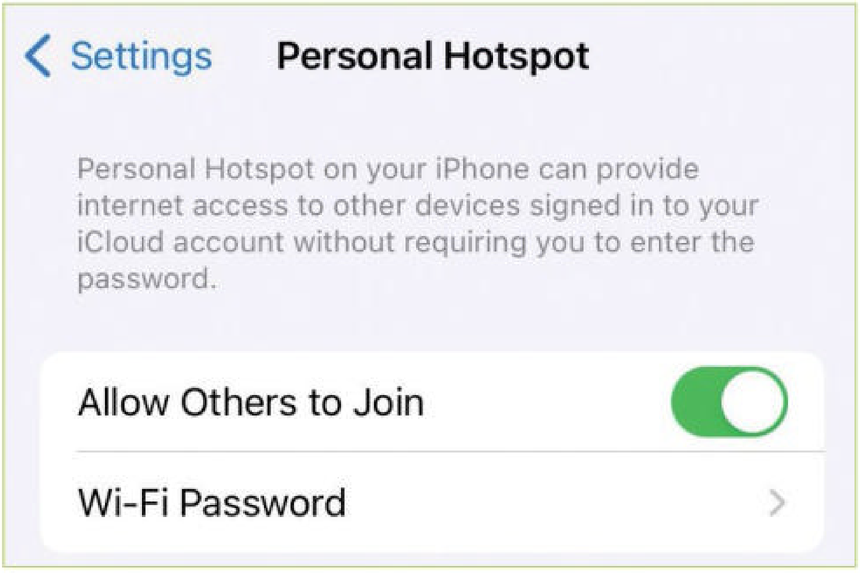
1 KEEP YOUR ROUTER RUNNING

The simplest solution to staying online is to connect your router to an uninterruptible power supply (UPS). These consist of a battery that's kept permanently charged, and a socket for your device. As long as the power keeps flowing, it passes through the UPS to the device—your router in this case—but, should the power fail, the battery takes over. How long it lasts depends on the router's power consumption and the size of the UPS battery.

» The router's consumption should be detailed in its documentation, on the back of the router itself, in the manual, or on the supplier's web pages. As a baseline, many basic routers supplied by Internet Service Providers (ISPs) should consume about 10W when active.

» You can divide down a UPS power capacity by this number to see how long it could support it. Amazon Basics' UPS ($80) is a 450W device, which could power the router for about 45 minutes in a blackout. That may be enough to keep you online during an unexpected blip, but it wouldn't keep you up and running through a longer outage or rolling blackout.

» A better, though more expensive option is Amazon Basics' UPS 1500VA ($170), which is a 900W device, meaning it should last 90 minutes. This might be long enough to see you through if you're careful, particularly if you can download any data you need in a short burst, then switch off while you deal with it.



Personal Hotspot on your iPhone can provide internet access to other devices signed in to your iCloud account without requiring you to enter the password.

Allow Others to Join: on

» **Share your phone's Wi-Fi connection by creating a mobile hotspot.**

2 USE YOUR PHONE'S WI-FI HOTSPOT

There's no point connecting your router to a UPS if your internet provider has also gone down. In that scenario, you need an alternative way to get online. For occasional use, you could share your smartphone's data connection by setting up a mobile hotspot.

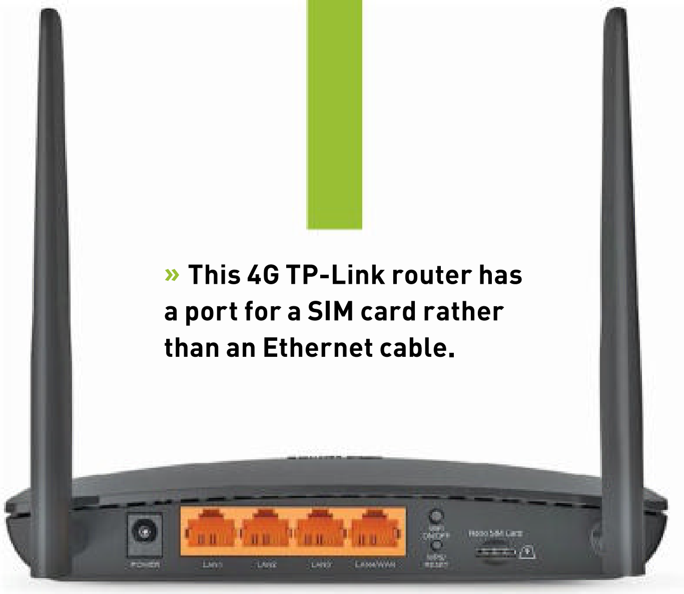
» To do this on Android, swipe down from the top of the screen, swipe the shortcut buttons to the left, then tap Hotspot. If the Hotspot button isn't shown, open Settings, type hotspot into the search box then tap 'Hotspot and tethering' twice. Tap 'Wi-Fi hotspot', then slide the switch beside 'Use Wi-Fi hotspot' to the right to turn it on.

» If you have an iPhone, open Settings and tap Mobile Data, followed by Personal Hotspot. Tap the slider beside 'Allow Others to Join' so it becomes green (see screenshot below).

» Now, whether you have an Android or iPhone, click Windows' Wi-Fi icon on the taskbar. On Windows 10, click the name of your phone in the list to use its connection. If you're using Windows 11, click the right side of the split button above your current network name, followed by the name of your phone.

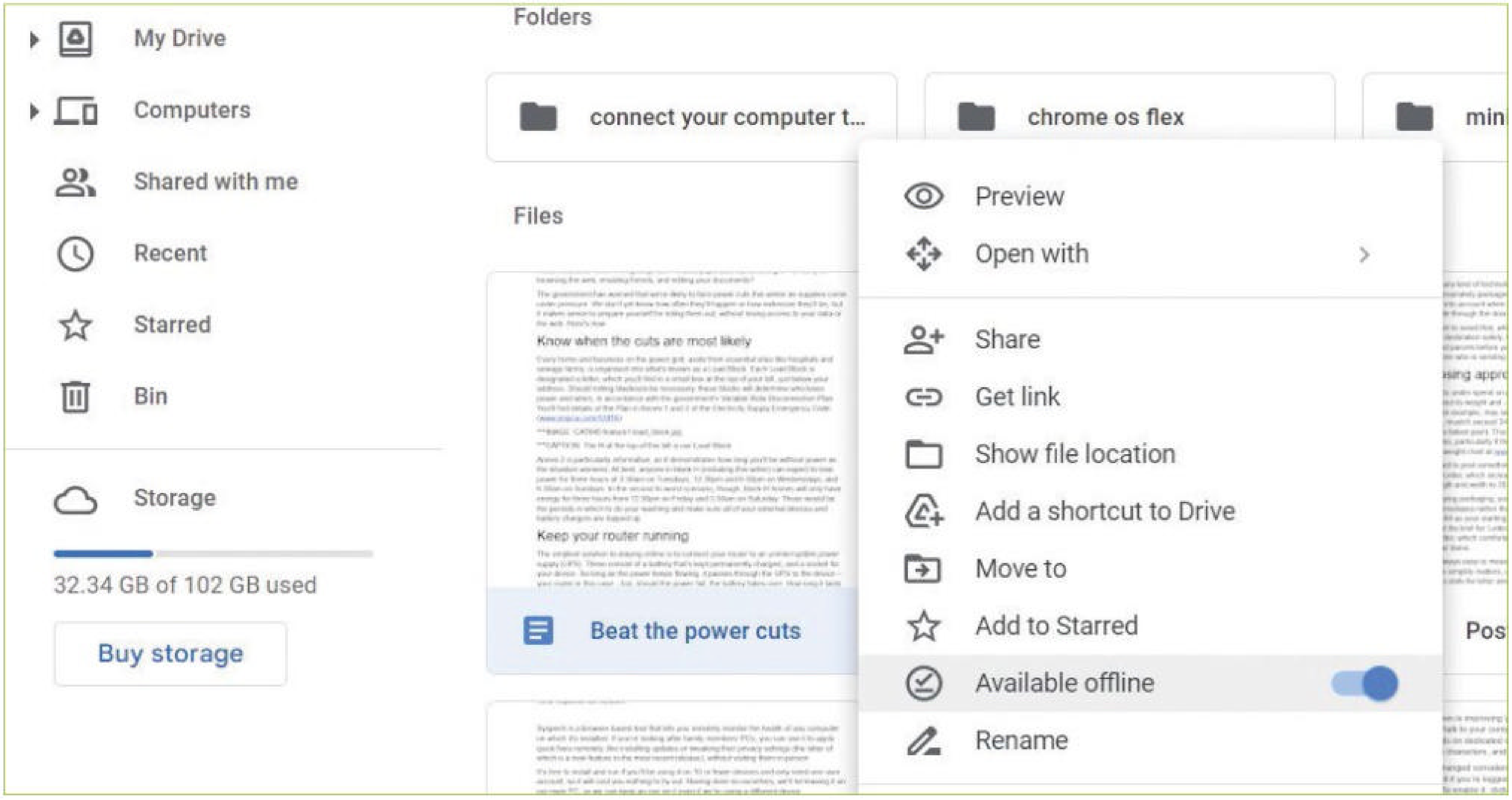
» Alternatively, purchase a 4G or 5G router, such as the TP-Link TL-MR6400 ($100), which has a slot for a regular mobile phone SIM rather than a wired broadband connection.

» If you're only going to use this if your regular router is out of service, look for a cheap pay-as-you-go (PAYG) deal with a generous data allowance. Whichever network you choose, check that it allows tethering, the technical term for sharing your mobile connection.



» **This 4G TP-Link router has a port for a SIM card rather than an Ethernet cable.**

© TP-LINK, GOOGLE


My Drive
Computers
Shared with me
Recent
Starred
Bin
Storage
32.34 GB of 102 GB used
Buy storage
Folders
connect your computer t...
chrome os flex
Files
Know when the cuts are most likely
Keep your router running
Beat the power cuts
Preview
Open with
Share
Get link
Show file location
Add a shortcut to Drive
Move to
Add to Starred
Available offline
Rename

» **Google Drive is an online office suite, but you can edit documents offline by activating this setting in advance.**

3 SWITCH TO OFFLINE TOOLS

If you use online software, consider using alternatives that you can download to your computer and run from it. For example, LibreOffice can stand in for Microsoft's online office apps when they are out of reach and is free to download from www.libreoffice.org.

» If you manage your emails using Gmail or outlook.com, you can download them using the free Thunderbird email client (www.thunderbird.net), write all your replies while you're still offline, and queue them to send the next time you connect.

» If you use Google Docs and Sheets, and access them through Chrome or Edge, you can set them to work offline. Start by adding the Google Docs Offline extension (www.chrome.google.com) to your browser, then open Google Drive's settings (https://drive.google.com/drive/settings). Tick the box beside 'Create, open and edit your recent Google Docs, Sheets, and Slides files on this device while offline'.

» Now return to your Google Drive account (https://drive.google.com), right-click on the files you want to be able to use without a connection, and click 'Available offline' (see screenshot above).

» Copies of these files will then be downloaded to your computer so that, even if the router fails, you will still be able to open them in your browser. ⏻

amazonbasics
amazonbasics

» **Amazon Basics' 1200W UPS should last for around two hours.**

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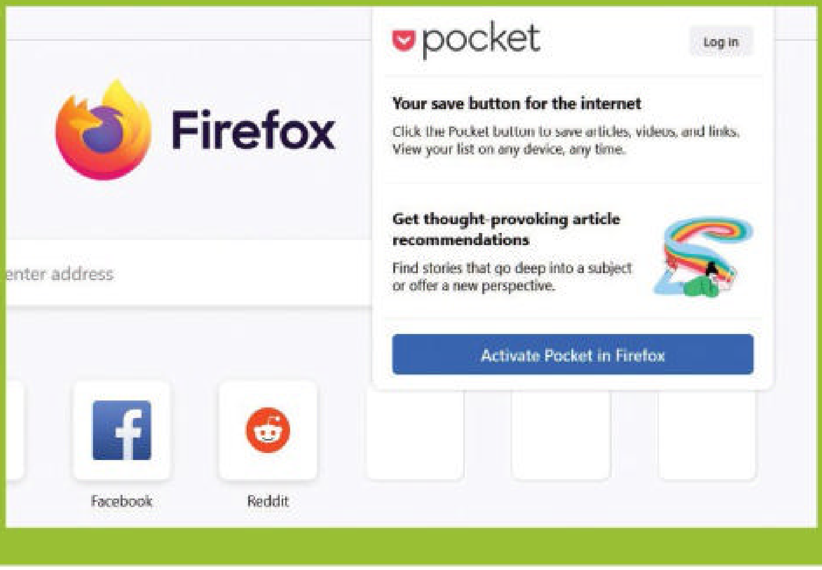
DOWNLOAD THE NEWS TO READ OFFLINE

You don't need to stay online when you're reading the news. Create a free account with Pocket (www.getpocket.com), and save the stories that interest you there. This is quick and easy if you install the Pocket button extension for Chrome-based browsers (https://chrome.google.com/webstore) or use the Pocket button built into Firefox—you'll find it to the right of the address box (see screenshot).

One click and Pocket saves a copy of the content open in your window to your personal Pocket account, which you can either read later in the browser (if you have power) or in a smartphone and tablet app. There are apps for both Apple (https://apps.apple.com/) and Android devices (https://play.google.com/store/apps), which download your recently saved stories every time you launch them. You can then disconnect from the web and read them at your leisure.


Firefox
enter address
pocket
Log in
Activate Pocket in Firefox
Facebook
Reddit

Your save button for the internet

Click the Pocket button to save articles, videos, and links. View your list on any device, any time.

Get thought-provoking article recommendations

Find stories that go deep into a subject or offer a new perspective.

Mount a mini PC to your TV or monitor

YOU'LL NEED THIS

TV OR MONITOR WITH VESA MOUNTING POINTS

Mini PC (we used the Chillblast WAP Ultimate AMD 3500U Micro)

Mounting Plate or Cradle (we used the Suptek Mini CPU Holder)

Screwdriver

ONE OF THE MAIN BENEFITS of buying a mini PC is the space you can reclaim on your desk. These miniature machines take up much less room than a conventional tower PC, or even an open laptop plugged into your monitor. To increase the benefit even further, you can go beyond this setup and tuck your mini PC behind the screen itself, creating a totally clean workspace and something that looks akin to having an all-in-one, at least when viewing from the front. And compared to buying most all-in-ones from manufacturers like HP and Apple, buying a monitor and one of these mini PCs is likely to be a much cheaper option.

These machines also make for popular media centers, so if you're using it as the hub of a home entertainment system, you can also attach one to the back of your TV. All you need is a VESA (Video Electronics Standards Association) mount adapter or cradle, a screwdriver, and some time to plan for the cabling and put it all together. This is one of those projects that once other people see what you've done, they'll be wanting to do the same! **–NIK RAWLINSON**

1 MEASURE YOUR MOUNT POINTS

Start by taking some accurate measurements of the mount points on your mini computer and the back of your screen. They may not align, but this isn't a problem, as we'll explain.

» On our mini PC (we used a Chillblast WAP Ultimate AMD 3500U Micro System) there are two mounting points, 85mm apart (pictured below left). However, the mounting points on the back of our monitor—of which there are four—are 100mm apart, and arranged in a square (pictured). Thankfully, each of these is a common measurement catered for in the VESA specifications. You can convert between the two using a VESA mount adapter.

2 CHOOSE THE RIGHT ADAPTER

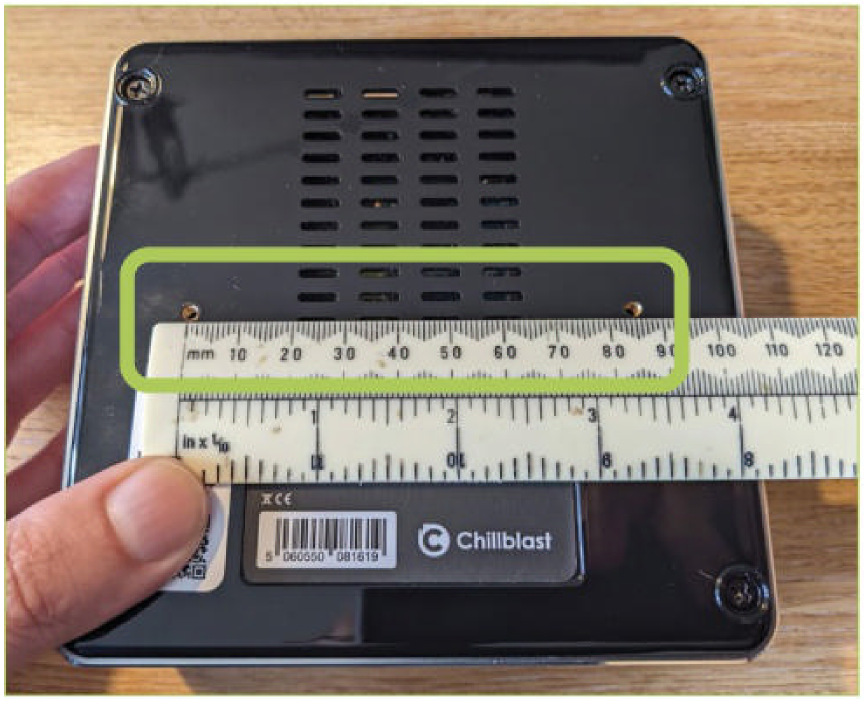
Even if the mount points on your computer and your monitor line up, you'll almost certainly still need to use an adapter. That's because you can't use double-ended screws to attach your computer to your monitor directly. Rather, you need to connect the computer to an adapter, then attach the adapter to the monitor, offset so that the computer doesn't obscure the mount points on the back of your screen.

» However, we have a different problem here. Although the mount points on our computer are closer together than the ones on our monitor, these are obscured by the computer case, which measures 130x127mm.

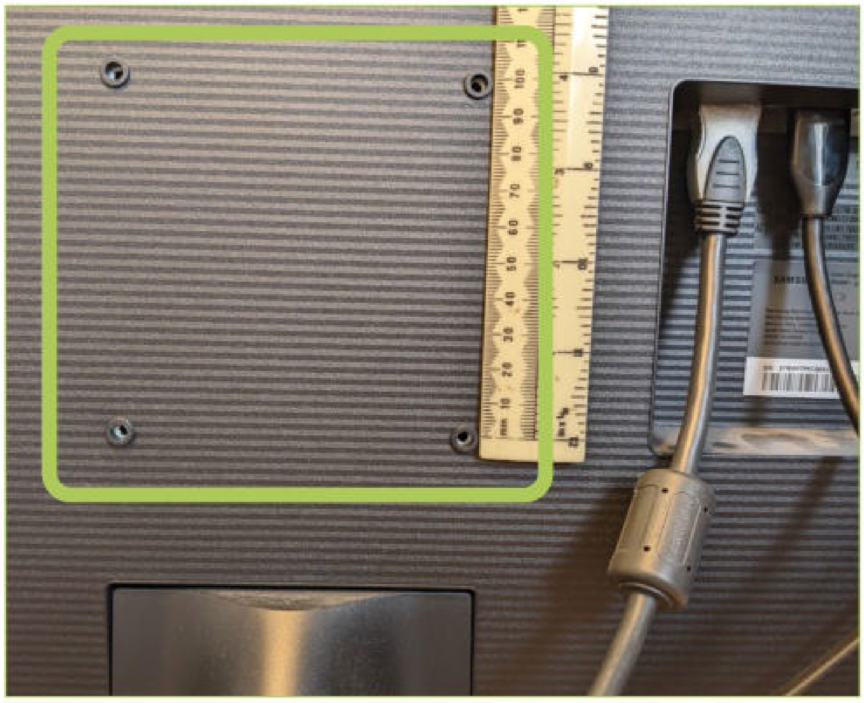
» If you don't have this problem, you may be able to attach your PC with one of the simplest adapters available—a single plate with multiple mount points for different fixings. For example, the Mount-It! VESA Mount Adapter Plate ($18) caters for nine different widths between 50mm and 420mm and six different heights between 50mm and 200mm.

» Alternatively, you can use a cradle, as we're going to do. In this scenario, the height of your PC also becomes important. Our mini PC is 52mm tall, so we need to make sure the cradle can accommodate at least that height, plus a few extra millimeters for padding and adjustment.

» We've therefore chosen a Suptek Thin Client Mount Bracket ($17), which has enough space for a PC case of up to 68mm. On the rear plate, it has mount points for 75x75mm and 100x100mm, the latter of which matches



» The mount points on the underside of our Chillblast mini PC are 85mm apart.



» Our monitor has four mount points, on the corners of a 100mm square.

the points on our monitor. The fact it doesn't have 85mm-spaced mount points to match our computer isn't a problem because we won't be screwing it into place.

3 FIX THE ADAPTER TO YOUR MONITOR

The adapter consists of two cross-shaped plates with a base. The plate with the shorter base sits within the other one and has two screws that protrude through the cut-outs in the base of the larger L and are topped off with a pair of nuts. Unscrew these and separate the two plates, then apply the supplied protective strips to each inner surface (pictured below). These are spongy and will be compressed when you slide the plates together with your computer between them, so should hold your PC in position and protect against scratches.

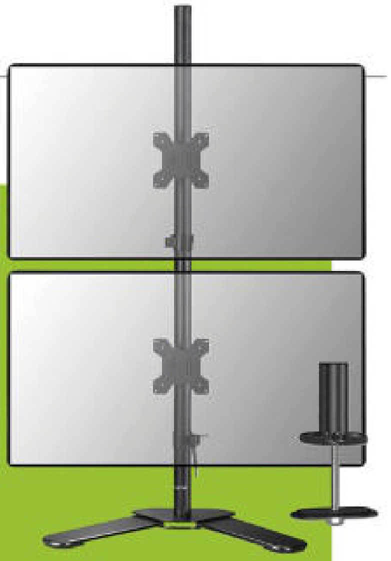
» Now fix the larger plate to the back of your monitor using four of the supplied screws (as pictured). The kit includes four sizes of screws for different mounting scenarios (see boxout). For the moment, though, we found the screws marked H2 were the perfect fit for our monitor, and in fitting them we worked on diagonal opposites, first lightly screwing in the top left, then the bottom right, after which we screwed the top right, then bottom left, before gently tightening each one. If the H2 screws don't fit your monitor, check whether the monitor's manufacturer included dedicated screws in the box.

» Once you've attached the larger plate, position the smaller one so that its integrated bolts are sticking through the cut-outs in the bottom of the larger plate. Loosely attach the wing nuts, then position your computer between the two plates. Slide the bundled strap behind your computer so that it loops around the computer and the outside of the smaller L plate (as pictured).

» Now, holding your mini PC in place, push the two plates together until the protective pads come into contact with the chassis, then tighten the wing nuts to secure your device. Tighten the strap to prevent your computer from falling out of either side of the bracket should you swivel or knock your monitor.

» When positioning your PC, it's important to think about where the ports, power socket, power switch, and ventilation holes are located. Ours has ventilation on all four edges, and on its underside, so we couldn't avoid partially obscuring vents. If you can avoid this without also blocking a port or switch, orientate your computer to maximize its cooling potential. The back of your monitor can get hot, especially if it's large, and this heat may transfer to the computer.

FIX YOUR PC TO A POLE OR THE UNDERSIDE OF A DESK



Not all PC monitors or TVs have VESA mount points at their rear, but that doesn't mean you have to park your PC on your desktop—particularly if you use a mounting bracket like the one we've used here.

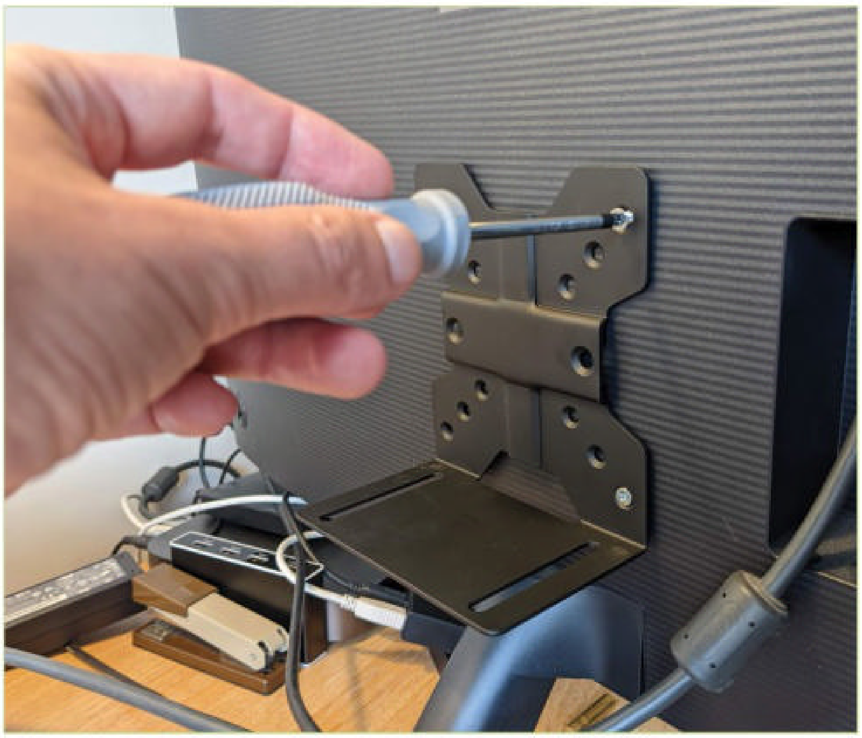
The reason there are four types of bolts included with our bracket (plus washers and nuts), is so that you can also use it to mount your mini PC on the underside of your desk. Simply use the four wood screws (labeled H1) to screw the larger L plate into the desk, then attach the smaller L in the way we explained above when fixing it to a monitor, only this time in a horizontal, rather than vertical orientation.

Alternatively, you can attach both your computer and monitor to a pole. Floor-standing poles, such as Suptek's Vertical Dual Monitor Mount ($47) are more common in offices, where workers use them to secure monitors and free up desk space.

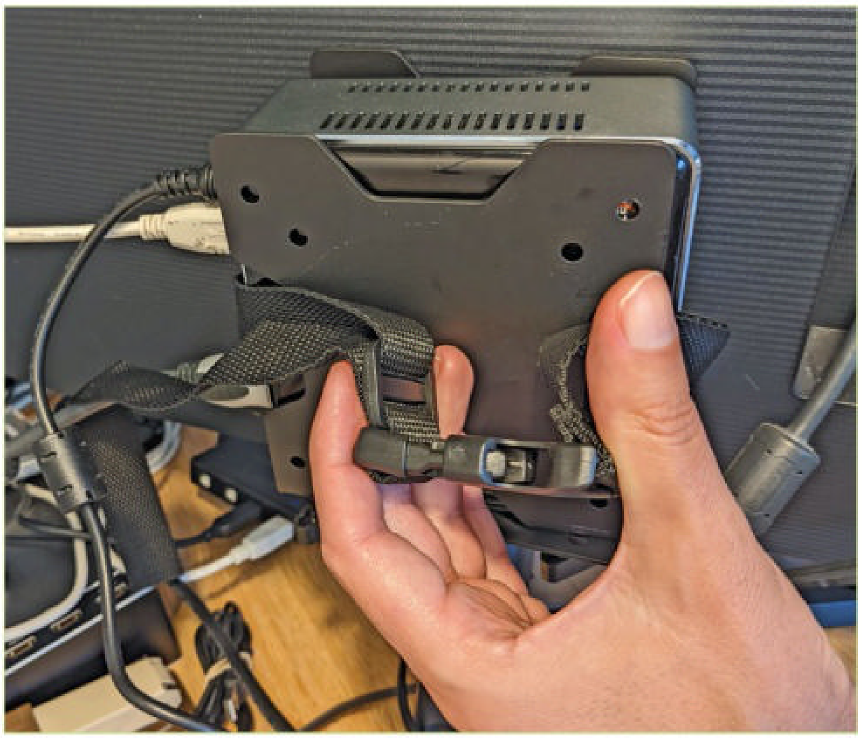
Mounting both the computer and monitor on a pole saves even more space, and involves attaching the smaller L plate to a bundled lock catch. This is a curved section of metal with screw holes at either end that goes on the opposite side of your pole to the L plate itself.

It's fixed into place using the bolts marked either G1 or G2, depending on the thickness of the pole. Once it is firmly in position, the lock catch should grip the pole and not slide down under the weight of your computer and monitor.

You can now fix the larger L plate to the back of your monitor, and use the wing nuts to fasten the two plates together, with the computer positioned between the two. Once again, the fabric strap will prevent your PC from falling out if you turn or knock the construction.



» Loosely fix all four screws before attaching the larger plate.



» Wrap this strap round your PC to keep it in position.

© SUPTEK

Send emails using your voice

YOU'LL NEED THIS

ANDROID, IOS, OR WINDOWS DEVICE
Windows 10 or 11
Email software
Headset or desktop mic

VOICE RECOGNITION is improving every year and getting cheaper too. A decade ago, if you wanted to talk to your computer rather than type, you'd have had to spend several hundred dollars on special dictation software. This would intercept everything you said, translate it into characters, and send it on to whichever program you were using. But things have changed considerably since then. Now, you can dictate directly into a Google Docs document using 'Voice typing' if you're logged in through Chrome. To enable it, click Tools at the top of a document, followed by 'Voice typing', then click the on-screen microphone and start talking.

Tools such as voice typing are a considerable time-saver if you're working on a lengthy document, but what if you're a slow typist who just wants to send a few emails and text messages? You can't do that in Google Docs unless you attach the document to a message using the File menu's Email section, which is probably overkill.

There's good news, though. Those improvements to voice recognition don't rely entirely on the power of an online office suite like Google Docs. In many cases, similar features are built into the operating system you use on your computer or phone, so you can use voice typing for a far more diverse range of tasks, including sending emails and texts.

Here, we'll explain how you can use your voice to send emails from a Windows PC, by taking advantage of their accessibility features. Many of these are easy to overlook if you don't otherwise need assistance using a keyboard or mouse. **–NIK RAWLINSON**

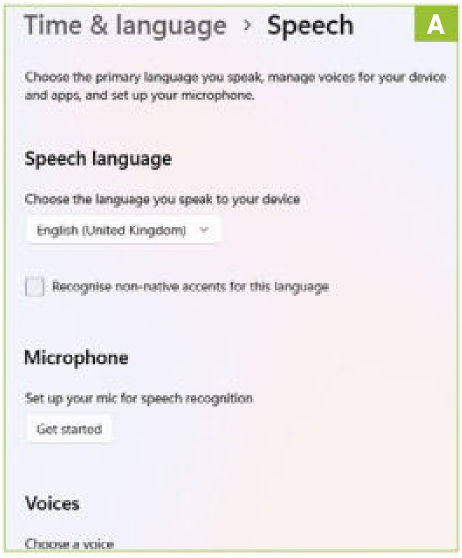
1 SET UP SPEECH RECOGNITION IN WINDOWS

Speech recognition isn't enabled by default. To turn it on in Windows 10 or 11, press Windows key+I to open Settings, then click 'Time & Language' followed by Speech. Now click the 'Get started' button in the Microphone section [**Image A**].

» Windows will now run its troubleshooter to detect any problems with your microphone [**Image B**]. If it spots any issues, click their entry and use the options that appear to try to remedy the problem.

» You then need to train the operating system to better recognize your voice. Start by pressing Windows key + Ctrl + S. The first time you do this, it will open the 'Set up Speech Recognition' tool (on subsequent presses, that keyboard combination will open speech recognition and wait for your spoken input). Click 'Next' on the first screen, and follow the instructions to train your computer to better understand what you are saying (see screenshot).

» Windows asks you what kind of microphone you're using, giving you options for a headset mic, which it claims is the most suitable for voice recognition, a desktop mic, and 'other', which is the option we selected because we're using a Blue Yeti microphone which costs around $100.



Choose the primary language you speak, manage voices for your device and apps, and set up your microphone.

Speech language

Choose the language you speak to your device

English (United Kingdom)

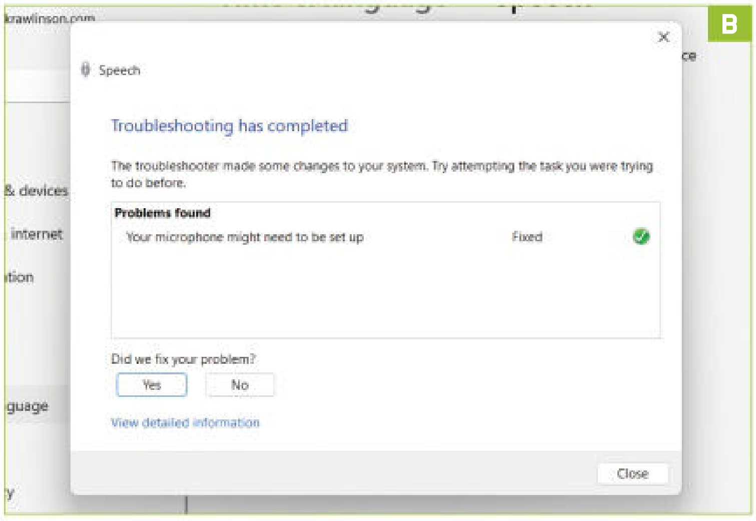
☐ Recognise non-native accents for this language

Microphone

Set up your mic for speech recognition

» Click 'Next', follow Windows' advice on how best to position your mic, then click Next again and read the sample sentence displayed on the screen.

» When you've finished, click Next twice, then choose whether to enable or disable document review by clicking the relevant button. Document review is a system where documents you've dictated are analyzed so the system can better understand how voice and text relate to one another, learn from what it discovers, and improve upon its performance.



Troubleshooting has completed

The troubleshooter made some changes to your system. Try attempting the task you were trying to do before.

Problems found

Your microphone might need to be set up — Fixed ✓

Did we fix your problem?

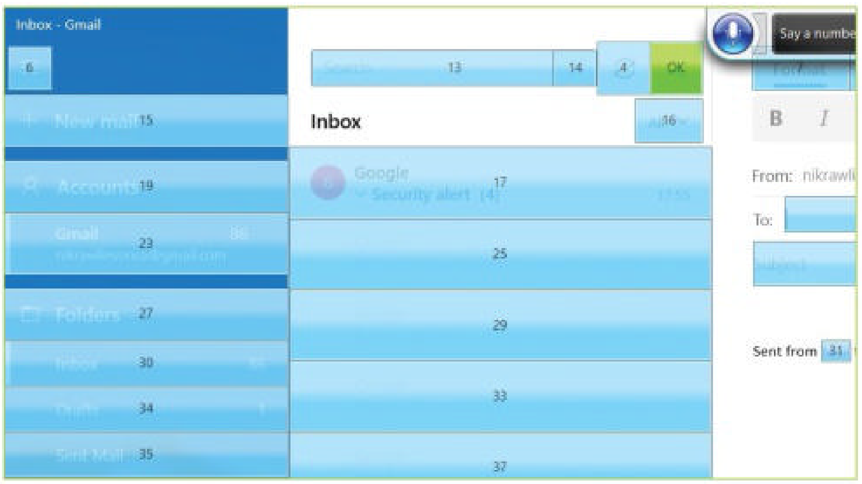
» Click 'Next' again, then decide how you want to launch speech recognition. You have two options: manual or voice activation. If you select manual (which is the default), you can start speech recognition by pressing Windows key+Ctrl, or by clicking the on-screen microphone that hangs down from the top of the Windows interface, and stop it by saying "stop listening". If you choose voice activation, you'll use the same "stop listening" command to bring a session to a close, and can restart it by saying "start listening".

» Click 'Next' until you reach the end of the instructions to complete set-up.

2 SEND AN EMAIL USING YOUR VOICE

Now that you've set up speech recognition in Windows, you can use it to control your PC and even send emails without using the keyboard or mouse.

© GOOGLE, MICROSOFT



» **When you need to click something with your voice, ask Windows to "show numbers".**

» Enable speech recognition either by clicking the mic on the bar at the top of the screen or by saying "start listening" if you opted for voice activation. Now launch or switch to the program you want to use to send your email. If you're using Windows' built-in Mail program, for example, say "launch mail". If it's obvious to Windows what you said, Mail will start instantly, but if it has any doubts, it will display a window showing various possibilities. Speak the number next to Mail.

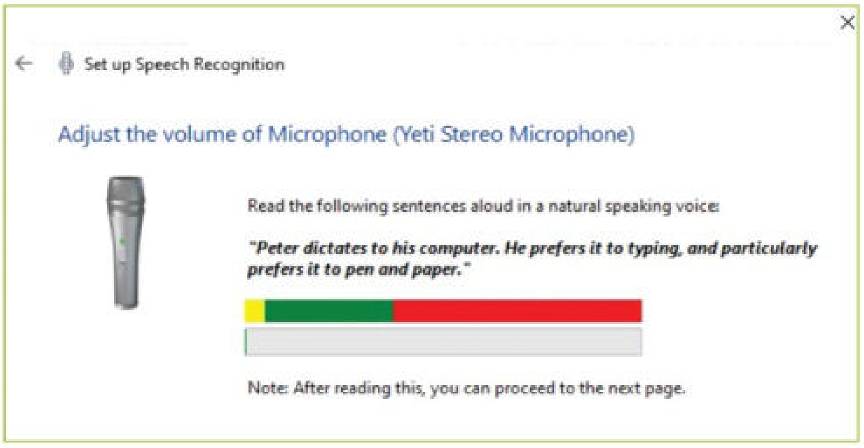
» In Mail, you create a new message by clicking the '+' in the left-hand sidebar. If you're wondering how you'll manage that without touching the mouse, the answer is quite simple: say "show numbers". This command, which works in any program, overlays clickable elements like the '+ New mail' button with numbers (see screenshot below). The numbers might be different every time you issue the command, even if you're using the same program, so don't just assume you know which one will be given to a particular command.

» In four separate tests, we saw the numbers 9, 15, 16, and 19 overlaying the '+ New mail' button. Speak the number for the object you want to click, then say "OK".

» With a new message open on the screen, the first thing you need to do is enter an email address. If you're using Mail, the cursor will already be positioned in the To field, but if you're using an alternative program, and the cursor is elsewhere, use the 'show numbers' command again, speak the number of the box that sits on top of the To field, then say "OK".

» Now dictate the recipient's email address. We found it easiest to do this by spelling it out character by character—for example, by saying "press n, press i, press k…". Here, Mail displayed a list of matching email addresses with the one we wanted highlighted, so we said "press return" to select it.

» If this doesn't work for you, and you need to spell out the whole of the email address, use "press at sign" for @, "press dot" for a full stop, and "press hyphen" for a dash. Check out Microsoft's full list of speech-recognition commands on its support website.



Set up Speech Recognition

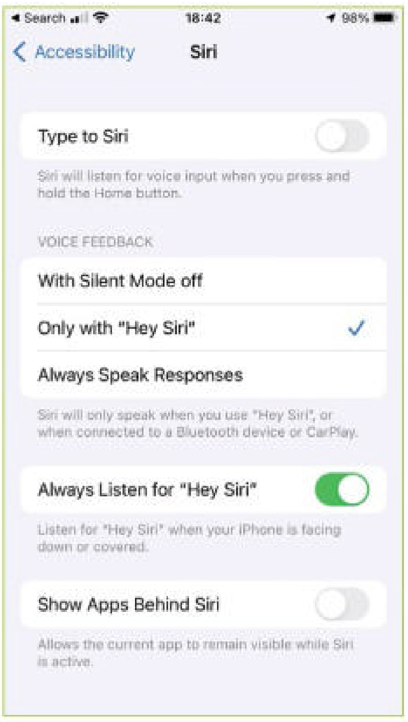
Adjust the volume of Microphone (Yeti Stereo Microphone)

Read the following sentences aloud in a natural speaking voice:

"Peter dictates to his computer. He prefers it to typing, and particularly prefers it to pen and paper."

Note: After reading this, you can proceed to the next page.

» **Read the sample message on screen to help Windows better recognise your voice.**



Search 18:42 98%

Accessibility Siri

Type to Siri

Siri will listen for voice input when you press and hold the Home button.

VOICE FEEDBACK

With Silent Mode off

Only with "Hey Siri" ✓

Always Speak Responses

Siri will only speak when you use "Hey Siri", or when connected to a Bluetooth device or CarPlay.

Always Listen for "Hey Siri"

Listen for "Hey Siri" when your iPhone is facing down or covered.

Show Apps Behind Siri

Allows the current app to remain visible while Siri is active.

» **Set your iPad or iPhone to listen for "Hey Siri".**

» Having dictated the email address, say "tab" as many times as is necessary to move the cursor to the subject line, then dictate your subject, and use the tab command again to move to the body text area of your message.

» At this point, you've done the most difficult bit. You can sit back and chat to your computer as though you were dictating to a secretary, albeit one that requires you to be explicit about where full stops, commas, and other punctuation should appear. If you want a carriage return, say "new line", and for a double carriage return, say "new paragraph". Again, these commands are included in the Microsoft list provided at the URL above.

» As you'll notice, it can take a lot less time to dictate a fairly lengthy email than it can to type it by hand, and once you get used to the idea of thinking on your feet, rather than pouring your ideas into a keyboard, you may find your language becomes more natural, too.

» When you reach the end of your message, sign off in the usual manner, then use 'show numbers' to overlay the on-screen buttons with digits. Speak whichever number sits on top of the send button, then say "OK".

USING YOUR VOICE ON MOBILE

The same principles above also apply to mobile, albeit with different mobile operating systems and assistants. On Android, you will first need to make sure Voice Access is enabled on your device. This requires Android 5.0 or later, and the Google app. The app should be built in, but if your device manufacturer didn't include it with the version of Android you're running, you can download it for free from the Google Play Store.

Once you've installed the Google App, it's worth enabling Hey Google detection so you can wake up your phone and start controlling it with your voice without first tapping it. Once done, to send a text, say "Hey Google text" followed by the name of the person you want to send a text message to. The recipient will already need to be in your contacts list.

On iOS, Open 'Settings', then tap Accessibility. Scroll down to the General section and tap Siri, then make sure the slider beside 'Always listen for "Hey Siri"' is green (see screenshot above). You can now speak to the phone without touching it. To send a text message, say "Hey Siri, send a message", followed by the name of the person you want to send the message to. Speak the content of the message, then pause. Siri will detect when you've stopped talking, and read back your message, before asking if you're ready to send it. If you are, say "yes". If not, say "no".

LAB NOTES

GUY COCKER, EDITOR-IN-CHIEF

Becoming more flexible

A love letter to the most versatile gadget around

APOLOGIES to anyone who might be sick of my regular gushing over Samsung devices this year. It's a recent phenomenon—I spent the last ten years before joining *Maximum PC* as a card-carrying iPhone fanboy, but this year, I had my head turned—first by the S22 Ultra, then by the Galaxy Tab S8 Ultra, the latter of which I reviewed in the May 2022 issue. But now I have a new device that's so good and so versatile, I'm going to happily trade both of them in.

That device is the Galaxy Z Fold4, which this month has comfortably replaced my mobile, tablet, and nearly my work laptop as well. If you're familiar with the device, you probably know one thing—that it's outrageously expensive, with a launch price of around $1,650. Thankfully, that price dropped to less than $1,000 at Christmas, meaning that after coveting it since launch in August, I could finally take the plunge.

I won't dwell on the phone's multi-tasking capabilities made possibly by that 7.6-inch screen, as that's been well covered by our sister publications, such as *TechRadar*, and, besides, it isn't really relevant to a PC magazine.

What's more interesting is just how much the Fold4 can replicate a laptop, from the Flex mode where you can bend the phone at 90° degrees and use the lower half of the screen as a trackpad, to the Windows-like DeX mode, which more closely replicates the Windows experience.

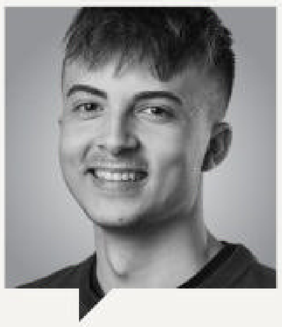
I visited my family over the Holiday period with the phone, a Bluetooth keyboard, and a mouse, and was able to wirelessly connect to my parents' spare television, from where I wrote this very article. As a result, the Fold4 feels like the most versatile device out there and very close to being the one gadget to rule them all.

Of course, there are flaws and limitations—the battery life is cripplingly low if you're using the Fold4 in DeX mode, you really need a USB hub and HDMI cable for stable, hi-res computing, and I wouldn't want to do anything too demanding like video editing on a phone—although LumaFusion makes a really good stab of it!

But if like me, you were holding off from getting yourself a foldable while their manufacturers worked out the kinks, I'd say now is the time to take a closer look.

My Fold4 will be replacing both my Galaxy S22 Ultra and Tab S8 Ultra phones.

© SAMSUNG



SAM LEWIS

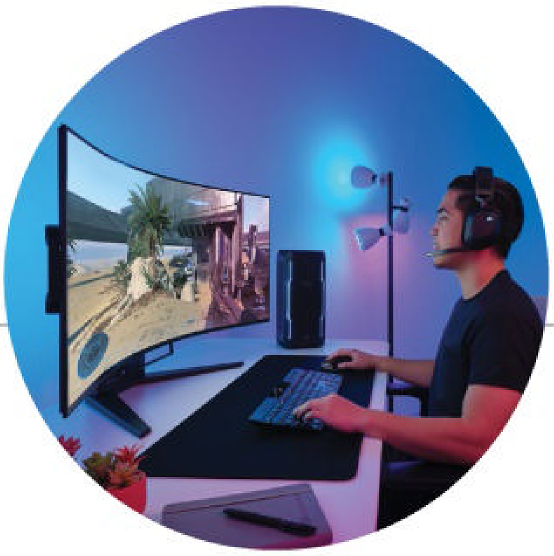
Staff Writer

At the time of writing, *High On Life*, one of the strangest and funniest games for a long while, has just been released. This hilarious twist on a typical casual space shooter comes from the brain of Justin Roiland (co-creator of *Rick and Morty*) and Squanch Games, that was enough to get me excited when the original trailer was released. In a world where the market is swamped with serious titles that have a huge focus on realism, this comedic masterpiece appears to be a throwback to when games used to be fun.

I was really keen to get my hands on it, and came pretty close to paying for the full game from Steam. However, before pulling the virtual trigger, I had a quick look around to see if I could get a better deal and, thankfully, it was also available on Xbox Game Pass. There's a lesson here—always spend that extra 10 minutes of research before buying a game so you don't make the same mistake I almost did.

The game strays away from the norm and, of course, contains much of the typical humor found in *Rick and Morty*. If that isn't your usual style of humor then this game won't be for you, as it's in-your-face and over-the-top right from the off. That said, I'm looking forward to all the many easter eggs, as well as laughing along to those Roiland-esque jokes and visual gags.

Corsair's new flexible OLED monster demonstrates the limitations of OLED technology all too clearly.



Editor's Pick: Corsair Xeneon Flex 45WQHD240

An OLED panel that lacks the Wow! factor

OLED PANELS ARE seen as the shizzle when it comes to premium screen technology. But like any new tech, OLED panels come with their own issues. For proof, look no further than the spectacular new Corsair Xeneon Flex 45WQHD240.

It's a 45-inch monster of a monitor with a 21:9 aspect OLED panel and loads of connectivity. It's flexible too, with a range of manually-adjustable curves available from completely flat through to 800R. Given the ultra-curved Samsung Neo G9 is only 1000R, at full bend, the new Corsair is certainly something.

As an OLED panel, it has all the usual advantages of that display tech. There's per-pixel lighting with perfect black levels and response times that make LCD monitors look like they've been caught napping. Yet OLED panels aren't perfect, not even close. If you're new to OLED tech, there's a learning curve to surmount.

OLED displays generally have no problems winding up the brightness over a limited proportion of the overall panel for small objects or windows. But you run into problems with larger objects or full-screen brightness. In those scenarios, the power consumption and heat output have to be controlled, which effectively leads to brightness being heavily throttled.

The upshot is that Corsair rates the Xeneon Flex at 1000 nits peak brightness but just 150 nits full screen. It also quotes 450 nits in a 25 percent window and 800 nits in a 10 percent window. It makes it difficult to know what to expect in terms of real-world brightness. I mean, how bright is this thing showing an outdoor scene in a typical game? That's what you want to know and the stats aren't hugely helpful.

The answer is not very bright. Definitely less bright than, say, a conventional LCD monitor rated at 400 nits. I'd guestimate equivalent to an LCD monitor roughly in the 250 nit range. It just isn't terribly punchy and that's disappointing for a monitor with a $2,000 sticker price.

In darker scenes with a relatively small proportion of bright objects or light sources, the Xeneon Flex looks great. The black levels are fantastic and the contrast with bright objects is more precise than you get with even the best mini-LED LCD monitors. But the wow factor isn't there.

Now, it doesn't have to be this way with OLED tech, at least not to this extent. The Alienware 34 AW3423DW, the only other true gaming monitor with an OLED panel we've seen, can hit 250 nits of full-screen measured brightness and performs like a 400 to 500 nit LCD monitor in terms of bright-scene performance.

The Alienware is much smaller, which may help. But LG's latest OLED TVs tend to perform better when it comes to panel brightness, so the problem can't simply be down to size. They are mostly a lot bigger than the Xeneon Flex, which uses an LG-sourced OLED panel. Part of the explanation may be that the Flex doesn't have a heatsink for the panel. A heatsink can allow an OLED display to run brighter.

If you look at how this screen's flexible panel is implemented, it's hard to imagine how a heatsink could be implemented while retaining the flex. If that's correct, I'd much rather see a fixed panel, flat or curved, and added brightness. As it is, the Corsair Xeneon Flex 45WQHD240 is an awful lot of money for an underwhelming experience. And that's before you consider the fact that it runs at just 3,440 by 1,440 pixels on a 45-inch diagonal. Yuck! **–JL**

$2,000, www.corsair.com

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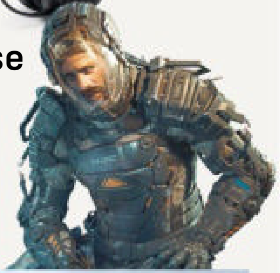

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Radeon RX 7900 XTX

Red Leader, standing by

LIKE THE PLUCKY Rebel Alliance preparing to attack the Death Star, AMD has been gearing up to try to take down Nvidia once again. The RDNA 3 architecture (see January issue) sounds promising and comes with some innovative new ideas. The hype has been building for months, and it's time to see whether the Force can be with AMD for a change. Rather than a spectacular explosion, unfortunately for AMD, it feels like the torpedoes have once again impacted on the surface.

The performance takes a healthy step forward, which is good news. The 7900 XTX beats AMD's previous generation RX 6950 XT by 40 percent in overall performance at 4K, and in a few instances, it can even deliver 70 percent more. But at 1440p, the advantage shrinks to 26 percent. Just as bad is the news that the

RX 7900 XTX mostly ends up matching the RTX 4080 in overall performance.

However, that requires a bit more explanation. There are games such as *Borderlands 3*, *Far Cry 6*, and *Watch Dogs Legion* where AMD's new Red Team leader does great. There are also plenty of situations where it comes up short, like anything that significantly uses ray tracing. That wouldn't be so bad, but Nvidia still holds the DLSS ace in its hand.

Turn on DLSS in quality mode and Green Team gets a 30 to 50 percent boost at 4K. Sure, AMD's FSR2 can mostly match DLSS in image quality, but it still has a way to go to catch up to DLSS adoption rates. At present, AMD has over 100 released and upcoming games with FSR2 support, but only 69 are presently available, and about 40 of those are lesser-known games. Nvidia has DLSS in 245 games, and while there are still plenty of esoteric names in the list, we'd say at least 60 of the games are well-known, and several (*Fortnite*, for example) are extremely popular.

It's not just about gaming, either. For professional applications like 3D rendering, Nvidia can offer over three times the performance. That's in Blender, but V-Ray and Octane are perhaps even worse, as they don't even attempt to support AMD's ray-tracing hardware. AI research is another area where Nvidia dominates AMD, and in some preliminary testing of Stable Diffusion (an AI text-to-art tool), the RTX 4090 was over five times as fast as AMD's 7900 XTX. Again, there are many AI projects that won't even work on AMD GPUs right now.

What about AMD's chiplet architecture, a first for consumer GPUs? Chiplets have worked wonders for AMD's Ryzen CPUs, but these first GPU chiplets feel like first-generation Ryzen. More importantly, AMD admits that GPU chiplets are more about reducing costs than improving performance, and they likely hurt performance through additional latency.

There's also the issue of pricing. We criticized Nvidia for increasing the generational pricing, particularly on the RTX 4080. The 7900 XTX has the same MSRP as the previous generation 6900 XT, but RX 6950 XT cards have been selling for $800 and the RX 6900 XT currently goes for $650, so a return to $999 feels like an increase. In fact, if we look at performance per dollar, all the latest generation graphics cards fall within a relatively narrow range of 0.053 to 0.058 FPS per dollar (at 4K across an expanded test suite).

The RX 7900 XTX is still a good card with plenty of performance, and it's not quite as chunky as Nvidia's 4080 Founders Edition. Rasterization performance remains a strong point, so if you don't care about DXR or DLSS, this is a better pick than the RTX 4080. But factor in Nvidia's lower power use (289W average across our test suite, compared to 350W for the XTX) and superior feature set, AMD's top offering at most keeps pace with Nvidia's second-tier GPU. **–JARRED WALTON**

VERDICT
8

Radeon RX 7900 XTX

⊞ LOCK S-FOILS AMD's fastest GPU; lots of VRAM; reasonable size and power.

⊟ DIDN'T GO IN Slower at RT; weak AI performance; DLSS still beats FSR2.

$999, www.amd.com

SPECIFICATIONS

Architecture	Navi 31
Lithography	TSMC N5P + N6
Boost clock	2500MHz
GPU shaders	12288
Memory	24GB GDDR6
TFLOPS FP32	61.4
Bandwidth	960GB/s
TBP	355W
Connectors	HDMI 2.1, 2x DisplayPort 2.1 USB-C (DP2.1)

AMD's reference RX 7900 XTX card seems compact compared with Nvidia's 4080 Founders Edition, but still weighs 1.8kg.

BENCHMARKS

	RX 7900 XTX	RTX 4090	RTX 4080	RX 6950 XT
10 Game Average (Geomean)	106 / 64	**135 / 93**	114 / 69	82 / 45
Borderlands 3	188 / 107	**219 / 130**	166 / 89	137 / 74
Control (DXR)	75 / 36	**138 / 68**	94 / 45	49 / 23
Cyberpunk 2077 (DXR)	42 / 21	**86 / 44**	63 / 30	27 / 12
Far Cry 6	**177** / 123	161 / **136**	158 / 108	149 / 91
Flight Simulator	83 / 73	**85 / 82**	82 / 76	83 / 48
Forza Horizon 5	147 / 111	**148 / 128**	130 / 103	137 / 91
Minecraft (DXR)	51 / 25	**102 / 62**	81 / 44	35 / 17
Red Dead Redemption 2	120 / 81	**161 / 111**	128 / 83	98 / 65
Spider-Man: Miles Morales (DXR)	79 / 45	**107 / 72**	96 / 58	63 / 35
Watch Dogs Legion	**150** / 96	147 / **116**	138 / 86	117 / 67

Best scores are in bold. All testing conducted with a Core i9-13900K, MSI MEG Z790 Ace, G.Skill 2x16GB DDR5-6600 CL34, 4TB Sabrent Rocket 4 Plus-G, and be quiet! Dark Power Pro 12 1500W. Scores are average framerates at 2560x1440 / 3840x2160 ultra, with ray tracing enabled in Control, Cyberpunk, and Spider-Man.

Radeon RX 7900 XT

Cut the chatter, Red Two

IN THE PAST, both AMD and Nvidia have had halo products with extreme prices and only moderately higher performance than the penultimate GPUs. With the latest generation of hardware, that approach seems to have been kicked to the curb and we're now looking at only minor cost savings for a potentially large performance deficit.

Nvidia blazed the trail with the RTX 4090 and 4080, with the latter shaving 25 percent from the asking price while also dropping performance (at 4K) by 25 percent. Now AMD is following suit, except the 7900 XT drops the price by just 10 percent while performance drops by 14 percent. That's an odd change of pace, and it immediately leads to the conclusion that the 7900 XTX is the better value—because it is.

We'll have to wait and see how prices shake out in the coming months. At launch, just like the 4090 and 4080, the RX 7900 series cards have sold out. That almost always happens, even without cryptocurrency miners buying them all up, but there are clear indications that scalpers and gamers aren't so excited about the 7900 XT. We could see street pricing fall to around $800 before too long, which would go a long way toward changing our opinion about the card.

Right now, however, despite what appears to be relatively decent specs on paper, the performance comes up short. That's not too surprising, as the move to a chiplet architecture and the additional FP32 shaders both mean raw specifications aren't as likely to match up with real-world results. The same thing happened with Nvidia's RTX 30-series when Nvidia doubled the number of FP32 shaders per SM. Now AMD's RDNA 3 architecture looks a lot more like Ampere and Ada, and it gets comparatively less from each theoretical teraflop.

On the other hand, real-world gaming performance differences between the 7900 XT and XTX closely match the specifications. The XTX model has 14 percent more GPU shaders and slightly higher boost clocks (though clock speeds while gaming were similar). It also has 20 percent more memory, bandwidth, and L3 cache. The result is 16 percent higher performance across our test suite.

The good news is that the 7900 XT still beats the performance of the previous generation RX 6950 XT, by 24 percent at 4K and 17 percent at 1440p The bad news is that it's also clearly slower than the RTX 4080: 20 percent slower at 4K and 16 percent slower at 1440p. It also falls slightly behind the previous generation RTX 3090 Ti—especially in DXR (DirectX Raytracing) games. It's basically on par with the previous-generation RTX 3090.

Other weaknesses echo what we said in the 7900 XTX review on the previous page (note that all the tests and settings are the same, so you can compare scores between all six GPUs in our two tables of results). AMD's GPUs can't support DLSS, FSR2 use isn't as prevalent, certain professional apps favor Nvidia GPUs, and AI researchers have focused on getting projects running on Nvidia's hardware.

AMD offers a few potential advantages, like a smaller card size and support for DisplayPort 2.1 54Gbps outputs. We'll likely see monitors with DP2.1 support start popping up soon. AMD also only requires two 8-pin power connectors, so there's no need to upgrade your PSU.

With the 7900 XT, we're ultimately left wanting more performance or a lower price. The second fastest GPUs of each generation have often had better values overall compared with the top models. The 6800 XT cost two-thirds as much as the 6900 XT in 2020 (if you could find one), and delivered 93% of the performance. But this generation seems to be chasing higher profit margins, perhaps thinking wistfully of the past two years of over-inflated GPU prices. **–JARRED WALTON**

The RX 7900 XT looks a lot like its bigger sibling, but there's no RGB lighting and it has slightly smaller fans and dimensions.

VERDICT
7

Radeon RX 7900 XT

+ WOMP RATS Second fastest AMD GPU; still plenty of VRAM.

– DIANOGA Still expensive; quite a bit slower than the XTX.

$899, https://www.amd.com

SPECIFICATIONS

Architecture	Navi 31
Lithography	TSMC N5P + N6
Boost clock	2,400MHz
GPU shaders	10752
Memory	20GB GDDR6
TFLOPS FP32	51.6
Bandwidth	800GB/s
TBP	315W
Connectors	HDMI 2.1, 2x DisplayPort 2.1 USB-C (DP2.1)

BENCHMARKS

	RX 7900 XT	RTX 4080	RX 6950 XT	RTX 3090 Ti
10 Game Average (Geomean)	96 / 55	**114** / **69**	82 / 45	98 / 59
Borderlands 3	165 / **89**	**166** / **89**	137 / 74	140 / 81
Control (DXR)	63 / 30	**94** / **45**	49 / 23	83 / 41
Cyberpunk 2077 (DXR)	36 / 17	**63** / **30**	27 / 12	51 / 25
Far Cry 6	**172** / 106	158 / **108**	149 / 91	147 / 96
Flight Simulator	82 / 63	82 / **76**	**83** / 48	**83** / 59
Forza Horizon 5	131 / 98	130 / **103**	**137** / 91	103 / 79
Minecraft (DXR)	45 / 22	**81** / **44**	35 / 17	70 / 37
Red Dead Redemption 2	111 / 74	**128** / **83**	98 / 65	106 / 71
Spider-Man: Miles Morales (DXR)	73 / 41	**96** / **58**	63 / 35	80 / 48
Watch Dogs Legion	**138** / 83	**138** / **86**	117 / 67	114 / 72

Best scores are in bold. All testing conducted with a Core i9-13900K, MSI MEG Z790 Ace, G.Skill 2x 16GB DDR5-6600 CL34, 4TB Sabrent Rocket 4 Plus-G, and be quiet! Dark Power Pro 12 1500W. Scores are average framerates at 2560x1440 / 3840x2160 ultra, with ray tracing enabled in Control, Cyberpunk 2077, and Spider-Man.

Noblechairs Legend

Gaming chair is a triumph of style and substance

IF YOU EVER DROP by the r/pcmasterrace subreddit, you'll find plenty of posts with titles like "Noblechairs vs. Secret Lab", where a newbie asks the companies' many fans to evangelize for their chair manufacturer of choice. It's pretty close and, based on our experience, you can't really go wrong with either brand. But can Noblechairs finally pull away from its competitor with its new Legend model, which promises to take the best features of its other offerings and combine them into one brand new super chair?

Our review model of the Legend is the Black Edition, which is much stealthier than most gaming chairs with its dark matte finish in faux leather material (fabric is also available for around $50 less). Noblechairs sells other colors of the Legend, including the Black/White/Red edition which boasts more of a racer aesthetic, but even that is much more subdued than most gaming chairs. Only a silver eye-hole below the headrest breaks the uniform design, which is a style we like and is equally suited to live streaming as it is office Zoom calls. Certainly compared with the racing red Backforce V that we reviewed in the November 2022 issue, the Noblechairs Legend will more readily fit into a home office without standing out.

On a functional level, the Legend is meant to bring together the best features of Noblechairs' other models, including the eye holes and the sportiness of the Epic, the sleekness of the Icon, and the build quality and lumbar support of the Hero. The result is what Noblechairs calls its "most sophisticated" chair yet, and to be honest, it's hard to argue with that assertion. As you put the chair together, everything from the wipe-clean instruction booklet to the beautiful stitching on the cover and the incredibly sturdy components screams quality. And while it takes longer to construct than most gaming chairs (Noblechairs recommends two people, but I was able to do it myself in about an hour), the resulting chair feels built to last, while offering a plethora of adjustable features for you to customize it to your comfort.

For example, the armrests move around on pretty much every axis imaginable, even twisting outward and inward depending on how you contort your arms. The back will recline to the point where you could feasibly take a midday snooze, and you can then lock it in that position. The chair also rises nice and high, allowing you to tower over your co-workers if you're in a shared office. There are also a few premium comfort features, such as a ratchetless wheel on the side of the chair which adjusts the lumbar for those who need lower back support. We also liked the positioning of the chair's base, which stays well out of the way of your feet, even if you tuck them under the chair.

Less successful, for me at least, was the two included cushions that can be used to support your lower back and your head. Yes, they're soft and they feel premium, but I found they pushed me too far forward in the chair to be comfortable. This could be down to personal preference though, and they would probably adapt to your body shape over time through continued use. And at least they're included in the box and not optional extras you have to purchase.

It's not all rainbows and sunshine, however. The two aforementioned cushions use straps to attach to the chair—we prefer Secret Labs' use of magnets, which looks and feels far more elegant. The warranty is also slightly concerning at only two years, way lower than other (cheaper) chairs like the Backforce, which offers 10 years.

At its price point, the Noblechairs Legend isn't cheap, nor is it particularly exciting. But it's clearly designed to fit into as many different environments as possible, it's luxurious to sit in, and the solid construction feels reassuringly built to last. It sits happily at the top of the premium gaming chair category and will more than satisfy anyone who has the money to buy it. **–GUY COCKER**

VERDICT

8

Noblechairs Legend

➕ **LEGENDARY** Gorgeous design; lots of adjustable settings; high build quality.

➖ **LACKLUSTRE** Optional cushions look and feel basic; short two-year warranty

$689, www.noblechairs.com

SPECIFICATIONS

Weight	30kg (66.1lbs)
Maximum load	150kg
Backrest adjustability	90° to 125°
Warranty	2 years
Pillows	2x (included)
Features	Integrated adjustable lumbar support, adjustable seat height
Materials	Steel (frame), cold foam (inner cushioning), polyurethane (cover), aluminum (base)

noblechairs
noble
noblechairs

The stealthy look means this chair will fit nicely into any home or office.

SOLIDIGM
P44 Pro
PCIe 4.0 NVMe M.2 SSD

The Solidigm P44 Pro is both a performance beast and great value for money—a killer combination.

Solidigm P44 Pro

A great value, high performance drive from an SSD underdog

WE REVIEWED THE SK Hynix Platinum P41 in our October 2022 issue, calling it "one heck of an SSD", scoring it a 9 and officially welcoming manufacturer SK Hynix to the big leagues. We now have the Solidigm P44 Pro, which is built on the same Platinum P41 components, but adds new software and cuts the price to even more competitive levels. Has Solidigm stood on the shoulders of giants and achieved perfection?

The drive sits on the cutting edge of SSD technology, although that target is set to move shortly with the release of the first PCIe 5.0 drives. In the here and now, though, the Solidigm P44 Pro still packs a punch with its PCIe 4.0 specification, a quoted 7,000MBps sequential read and 6,500MBps sequential write speed, and for this 2TB version, a 1,200 Terabytes Written lifespan. Other capacities (512GB and 1TB) have a lower lifespan, but there's a five-year warranty across all three models, which is better than big-name manufacturers such as Samsung.

Another plus point for the Solidigm P44 Pro drives is the price. At $220 for this 2TB model compared with $260 for the SK Hynix equivalent, they offer a reasonable saving. The 1TB drive is $130, while the 512GB drive is $80—both are also good value compared with the competition. Sadly, Solidigm doesn't make any versions with heatsinks, nor does it do a 4TB version. If these are your priorities, then cast your eye toward the WD_BLACK SN850X range.

The P44 Pro works with three pieces of software downloadable from the Solidigm website, two of which are driver and firmware-based, with the former enabling host-managed caching (HMC). The third, called Storage Tool, also allows you to update firmware and is a feature-packed suite with a GUI offering info on the general health and features of the SSD. It's not something you'll need to open regularly, but it can help you make sure the drive is performing as it should, and identify any issues if they arise.

This single-sided drive comes with a controller, DRAM, and two NAND packages, with the Aries controller able to raise IOPS performance to incredible heights. The drive also comes with SK Hynix's 2GB LPDDR4 for the drive's DRAM cache, which is plenty for a 2TB drive, as well as identical flash to the Platinum P41 in the form of 176-layer TLC. No concerns from us in terms of the components used.

Thankfully, this is borne out in terms of performance on the Solidigm P44 Pro, which is excellent, and only consistently beaten at the time of writing by Samsung's recent 990 Pro drive. That said, Samsung's is a more expensive drive (around $300 for the 2TB drive), and the P44 Pro comes within such close distance in the benchmarks that it's the much better buy overall. It also scored well in the 3DMark test, an area the Nextorage over the page struggled with.

Solidigm's drive takes the top prize when it comes to efficiency, however, offering more performance per watt when copying files than any other drive we tested. It's also efficient when idle—an important consideration in these energy-premium and efficiency-conscious times. In terms of temperature, Solidigm's drive idled at about 41°C and hit a throttling temperature of around 82°C after 450GB of writes, at which point performance dropped considerably. We would, therefore, recommend using a heatsink for this drive.

With its brilliant performance, competitive pricing, and excellent software, the Solidigm P44 Pro deserves to be top of any prospective SSD buyer's list. It needs a heatsink if you're going to be doing big file transfers, and we'd love to have seen a 4TB version, which may yet arrive. For now, though, Solidigm's P44 Pro is a remarkable statement of intent and puts other SSD manufacturers on blast. **–GUY COCKER**

BENCHMARKS

	Samsung 990 Pro 2TB	WD_BLACK SN850X 2TB	SK Hynix Platinum P41 2TB	Solidigm P44 Pro 2TB
Peak Sequential Read (MBps)	4,019	5,214	3,999	**4,042**
Peak Sequential Write (MBps)	**1,905**	1,845	1,890	1,891
PCMark10 Storage Index	**4,651**	3,846	3,850	4,397
PCMark10 Storage Bandwidth (MB/s)	**743**	607	621	701
PCMark10 Storage Latency (microseconds)	**36**	43	43	38
CrystalDiskMark SEQ1M Q8T1 Read (MBps)	7,153	6,982	**7,171**	7,168
CrystalDiskMark SEQ1M Q8T1 Write (MBps)	**6,820**	6,676	6,676	6,682
CrystalDiskMark RND4K Q1T1 Random Read Latency (microseconds)	**39.7**	43.7	44.8	44.1
CrystalDiskMark RND4K Q1T1 Random Write Latency (microseconds)	13.3	10.9	11.3	**10.4**

Best scores are in bold. Our test bench consists of an Intel Core i9-12900K CPU, ASUS ROG Maximus Z690 Formula motherboard, 2x16GB Corsair Dominator DDR5 5600 CL36 RAM, and Windows 11 Pro.

VERDICT

9

Solidigm P44 Pro

⊞ **SOLID AS A ROCK** Fast performance; great software; five-year warranty; keen price.

⊟ **SOFT AS A MARSHMALLOW** Beaten by Samsung 990 Pro; PCIe 5.0 drives on the way.

$220 (2TB, tested), $130 (1TB), $80 (512GB)
www.solidigm.com

SPECIFICATIONS

Format	M.2
Capacity	2TB (version tested)
Interface	PCIe 4.0
Controller	SK Hynix Aries
Memory type	176-layer TLC NAND
Cache memory	2GB DDR4
Sequential read	7,000MBps
Sequential write	6,5000MBps
Read IOPS	1.4M
Write IOPS	1.3M
Write endurance	1,200TB
Warranty	5 years

Nextorage NEM-PA 2TB

Sired by Sony, this SSD is seriously speedy

NEVER HEARD of Nextorage? Neither had we before this 2TB SSD landed in the *Maximum PC* labs. However, Nextorage is no obscure startup, even if its recent history is a little complicated. The company was born in 2019, founded by Sony as a direct subsidiary of Sony Storage Media Solutions Corporation, the idea being to produce SSDs for the PlayStation series of consoles. However, in early 2022, none other than Phison—a company famous for SSD controller chips—acquired a controlling stake in Nextorage and here we are reviewing the Nextorage NEM-PA 2TB, an M.2 with a broader remit that includes the PC.

Specs-wise, this is a high-end PCIe Gen 4 model. It packs 2TB of TLC 3D NAND flash memory and 2GB of DDR4 cache memory, all running over a quad-link interface. Perhaps unsurprisingly, given the Phison acquisition, it runs the Phison E18 controller, a chip that has delivered excellent performance in a range of premium Gen 4 SSDs, including the Seagate Firecuda 530, PNY XLR8 CS3140, Corsair MP600 Pro XT, Sabrent Rocket 4.0 Plus and many more. It's basically the go-to controller for companies not building their own in-house chip.

As for its claimed performance specs, Nextorage pegs this 2TB model at 7,300MB/s for reads and 6,900MB/s for writes. IOPS clock in at fully one million in both directions, all of which is par for the Phison E18 course, even if a few more recent drives with custom controllers, such as the SK Hynix Platinum P41 and Samsung 990 Pro offer significantly higher theoretical IOPS throughput.

Still, the Nextorage NEM-PA delivers decent write endurance at 1,400TB for this 2TB drive and a nice, reassuring five-year warranty. Nextorage also says that up to one-third of the drive's capacity can be allocated to run in speedy SLC cache mode. And so it pretty much proves in practice. In our testing, the drive runs at full speed for around 625GB of writes before transfer speeds fall slightly before then dropping off more substantially after 800GB of writes.

READING ABILITY

Those figures are much higher than the competition, which is a good start. The 2TB version of the Samsung 990 Pro, for instance, only managed 230GB of writes at peak performance. Elsewhere, the Nextorage NEM-PA mostly maintains that impressive pace.

It is pretty much bang on the claimed numbers for sequential speeds, with 7,327MB/s reads and 6,867 writes, and therefore right up there with the very fastest drives. It's not going to be until PCIe Gen 5 drives arrive that we see substantially faster peak SSD speeds.

The same goes for 4K random access performance, with the Nextorage NEM-PA 2TB clocking up 83MB/s reads and 252MB/s writes, both figures very much in line with the best of the competition. Even more impressively, it does all that while staying remarkably cool. We recorded a peak temperature of just 39°C, some way below the 71°C of the SK Hynix Platinum P41 and 59°C of the Samsung 990 Pro. No doubt the hefty, nicely engineered heatsink originally designed to keep the drive cool inside the narrow confines of a PS5 console is a factor. But even so, this SSD runs remarkably cool.

If that's an extremely impressive run for a hitherto unheralded SSD outfit, the NEM-PA does slightly underperform in PCMark 10, with bandwidth and latency that's slightly short of the very fastest drives. The Samsung 990 Pro in particular is quite a bit quicker in PCMark 10. It's not clear why this Nextorage drive didn't quite cut it in PCMark. But it's not enough to spoil what is a particularly strong first showing. At the right price and especially if you have concerns about operating temps, this SSD should certainly be on your shortlist. –**JEREMY LAIRD**

VERDICT

9

Nextorage NEM-PA 2TB

+ BIG BANG Runs incredibly cool; mostly great all-round performance.

− HEAT DEATH Slightly substandard PCMark 10 performance

$229, www.nextorage.net

BENCHMARKS

	Samsung 990 Pro 2TB	Seagate Firecuda 530	SK Hynix Platinum P41	Nextorage 2TB
PCMark10 Storage (full) Index	**3,645**	3,021	3,477	3,012
PCMark10 Storage (full) Bandwidth (MB/s)	**570**	487	542	484
PCMark10 Storage (full) Average Access Time (μs)	**45**	56	47	56
Peak Operating Temperature (°C)	59	41	71	**39**
CrystalDiskMark 7.0.0 SEQ1M Q8T1 Read (MB/s)	**7,462**	7,334	7,375	7,327
CrystalDiskMark 7.0.0 SEQ1M Q8T1 Write (MB/s)	**6,877**	6,874	6,872	6,867
CrystalDiskMark 7.0.0 RND4k Q1T1 Read (MB/s)	80	**83**	**83**	**83**
CrystalDiskMark 7.0.0 RND4K Q1T1 Write (MB/s)	231	251	**255**	252

Best scores are in bold. Our test bench consists of an AMD Ryzen 7 3800X, Asrock taichi B550, Nvidia GTX 1080, 16GB GSkill DDR4, and Sabrent Rocket 4 Plus OS SSD.

SPECIFICATIONS

Format	M.2
Capacity	2TB
Interface	PCIe 4.0
Controller	Phison E18
Memory type	3D TLC NAND
Cache memory	2GB DDR4
Sequential read	7,300GB/s
Sequential write	6,900GB/s
Read IOPS	1M
Write IOPS	1M
Write endurance	1,400TB
Warranty	5 years

The Nextorage's beefy heatsink is designed for consoles but works pretty well in a PC.

Asus ROG Strix B650-A Gaming WiFi

Should you get on board with this feisty B650-A offering from Asus?

The Asus motherboard looks the part, if you can ignore the trite gaming slogans.

CHOOSING A TRUSTY motherboard for your new build is like building a solid foundation for your house. If you don't quite get it right, everything will inevitably go wrong. The motherboard pieces together all of your components so they work as efficiently in tangent, so having a top-quality mobo with lots of compatibility options is important. They are also a pain to swap out if you need to change them around—unfortunately, it's not like changing your RAM—so, it's best to get it right in the beginning.

The board we have here is the Asus ROG Strix B650-A Gaming WiFi, the cheapest Strix mobo in the lineup for the new AM5 socket. It sits at the bottom of the current Strix lineup, mainly because the chipset is a B650. Above that are the more powerful chipsets, the B650E and X670E models, yet the B650 platform still allows you to use the AMD 7000 Series AM5 processors, DDR5 RAM, PCIe 5.0 NVMe support, and AMD EXPO for easy overclocking. That's not a bad set of future-proofing essentials, so is it being undersold by its position in Asus's 2023 hierarchy?

Also included in the box are a WiFi 6E antenna, the manual, M.2 Q-Latch package (instead of M.2 screws), two SATA 6Gb/s cables, a thermal pad for M.2, cable ties, and of course, the obligatory key chain and stickers. That's a healthy bundle of accessories and extras for this board. We are especially grateful for the switch from the standard M.2 screws to the M.2 Q-Latch, which is far easier to use and saves us no end of time when swapping out SSDs.

One of the main things to take away from the specs is that the Asus mobo features ultra-snappy WiFi 6E technology to capture the new 6GHz band. Of course, you will need compatible WiFi to take advantage of this, but for future-proofing purposes, it offers some peace of mind. As for ethernet, the board supports Intel 2.5G ethernet for speedy downloads and low-latency gaming too. Other features on the board include three M.2 slots, four DIMM DDR5 slots, four 4-PIN PWM/DC fan headers, a CPU fan header, an AIO pump fan header, a PCIe 4.0 x16 SafeSlot (CPU), a PCIe 4.0 x16 Slot (Chipset), two PCIe 4.0 x1 slots (chipset), an abundance of heatsinks across the board and ROG SupremeFX audio. That's quite the selection to showcase both its compatibility and capabilities.

On the I/O shield, there is a vast choice of ports with the most notable including the HDMI, DisplayPort, BIOS FlashBack button, seven USB Type-A, and two USB Type-C ports, which should be sufficient for most desktop setups.

Design-wise, we are big fans of the ROG Strix boards, especially this ATX model in its white and silver color scheme. Overall, this mobo looks and feels sharp, with its razer-like metal heatsinks. We're also fans of the subtle RGB featured here on the ROG logo, which adds a splash of character to the clean aesthetic and is customizable via the Asus Aura Sync utility. One thing we can't really get behind are the generic gamer-inspired slogans that are dotted over the board. For example, having 'For those who dare' written on the M.2 drive takes some of the sleekness away from this motherboard. Yes, we are nitpicking, but this costs just shy of $300 and a few trite slogans don't really add anything. That said, the hidden retro-gaming touches around the board are a nice touch.

We used this board in this issue's RTX 4080 cover build, and loved the features that help increase its ease of use, including the Q-LED diagnostic system containing four onboard LEDs that indicate any potential issues with the CPU, GPU, memory, or boot device, which is handy for anyone using it in a new build. As we tested this with an RTX 4080 Founders Edition, getting to the PCIe clip was a bit of a nightmare, so using the PCIe slot Q-release button made removing this GPU a breeze. The same can be said for the BIOS FlashBack functionality, as our system required an updated BIOS to boot and this is by far the easiest method.

So, this B650-A Gaming WiFi has a huge arsenal of tricks up its sleeve boasting impressive compatibility, and great futureproofing support for the likes of AM5, DDR5, PCIe 5.0, and WiFi 6E. As well as looking aesthetically pleasing, it's also a breeze to build with and the overall build quality is impressive. All things considered, that's pretty good—the only issue is the price. You can pick up B650 AM5 DDR5 motherboards for around $170, so that's a hefty price difference if you're trying to stick to a budget. Yet, the Asus ROG Strix B650-A Gaming WiFi ticks lots of boxes, has longevity at its core, and shouldn't be overshadowed by its more powerful chipset siblings as this is one mighty speedy mobo. **–SAM LEWIS**

VERDICT

8

ASUS ROG STRIX B650-A GAMING WiFi

⊞ MAINFRAME Great ease-of-use; plethora of connectivity options; clean aesthetic; PCIe 5.0 and DDR5 support.

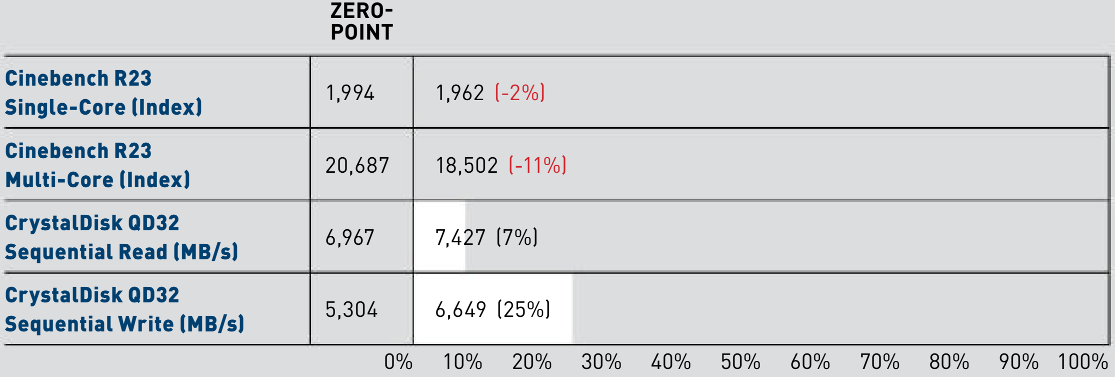
⊟ SUBFRAME Garish gaming lingo; slightly pricey.

$280, www.asus.com

SPECIFICATIONS

Size	ATX
CPU	AMD Ryzen 7000 Series
Socket	AM5
RAM	4x DDR5 (up to DDR5 6400+OC), 127GB limit
Chipset	AMD B650
Expansion	PCIe 4.0 x16 slot, PCIe 4.0 x16 slot (supports x4 mode), 2x PCIe 4.0/3.0 x1 slots
Storage	4x SATA 6Gb/s ports, M.2_1 slot (Key M), type 2242/2260/2280 (PCIe 5.0 x4 mode), M.2_2 slot (Key M), type 2242/2260/2280 (PCIe 4.0 x4 mode), M.2_3 slot (Key M), type 2242/2260/2280/22110 (PCIe 4.0 x4 mode)
Ports	USB 3.2 Gen 2x2 port (USB Type-C), 4x USB 3.2 Gen 2 ports (3x Type-A + USB Type-C), 4x USB 2.0 ports (4x Type-A), DisplayPort, HDMI, Wi-Fi Module, Intel 2.5Gb Ethernet port, 5x Audio jacks, BIOS FlashBack button
Audio	ROG SupremeFX 7.1 Surround Sound High Definition Audio CODEC ALC4080
Dimensions	12 x 9.6-inches

BENCHMARKS



Our zero-point consists of the slick and subtle 4090 rig from our January 2023 issue, featuring an Intel Core i5-13600K, PNY XLR8 Gaming VERTO EPIC-X RGB GeForce RTX 4090 24GB, MSI MAG Z690 Tomahawk Wi-Fi, 32GB (2x16) of Corsair Vengeance DDR5-4800, and 1TB WD_BLACK SN850 M.2 SSD. Our B650 system consists of our RTX 4080 machine from the Feberuary 2023 issueon page 16. It consists of an AMD Ryzen 7 7700X, Corsair Vengeance 32GB DDR5-4800 RAM and SK Hynix Platinum P41 PCIe 4.0 1TB SSD. No manual CPU overclocking was used.

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www.magazinesdirect.com/B2XMPC

HyperX SoloCast

Give your live streaming and conference calling an upgrade on a budget

A FEW YEARS AGO, there was an explosion of high-end microphones from companies such as Razer, Blue, and HyperX. They'd clearly all realized there was a nascent market of wannabe streamers, YouTubers, and content creators who wanted to sound good and look cool when making video content. Jump forward to today, and there are still lots of aspiring Twitch superstars, but there are far more people working from home who want to sound clear in their Zoom meetings, and who still might want to make video game content or podcasts in their spare time. Enter the HyperX SoloCast, a cut-down version of the company's existing mic offerings for a much more reasonable price.

Despite its RRP of $60, the SoloCast is readily available for $35, making it much cheaper than the QuadCast or QuadCast S that you may have seen capturing the audio for so many YouTubers out there. Unlike the large, cylindrical outline of the QuadCast, the SoloCast is much more compact, almost endearingly dinky in comparison. However, it still boasts that same reassuring feeling of quality, with a nice weight that keeps it planted to a desk, helped by the sturdy stand that comes included in the box.

SOLO PURSUITS

The SoloCast doesn't need to be as big because, as the name suggests, it only captures audio from one direction, literally casting one solo voice in what's known in audio terms as a cardioid pattern. The DuoCast and QuadCast have two and four different recording patterns respectively, making them better choices for podcasters or anyone who needs to capture multiple voices from different subjects using just one microphone—interviewers, for example. However, we'd guess that the majority of people need a microphone only to capture their own voice, making the SoloCast a great option for anyone who just hosts their own livestream, attends remote meetings for work, or hosts a podcast where everyone else contributes remotely.

The crucial part of the SoloCast's success is that its cardioid vocal performance is just as good as its bigger sibling's, which is to say that it produces, clear, rich, and full voice recordings. In fact, it goes some way beyond that—compared to the much revered Blue Snowball iCE at a similar price, we prefer the recordings we made with the HyperX SoloCast. The SoloCast also did a better job of isolating voices and omitting the click-clack of our Logitech mechanical keyboard on the same desk, which is an important consideration for streamers.

It's this performance, rather than the features, that makes the SoloCast a standout. That's because there isn't much else to speak about—there's no RGB lighting as with other more expensive HyperX mics, nor is there a headphone jack for monitoring, nor a switch to change recording modes. There is a touch-sensitive mute button on top, with a red light that flashes to indicate it's not recording. We love the mic stand which will angle the mic backward about 45°, as well as rotate sideways in each direction to better pick up your voice. You can also remove the mic from the included stand and attach it to a boom arm thanks to the threading hole on the bottom. The mic also uses the newer USB-C standard, which we liked, with a reasonably long 2m cable included in the box.

The HyperX SoloCast isn't a particularly exciting product, mainly because it lacks a lot of the bells and whistles that have become something of the norm in the PC mic space over the last couple of years. However, what it does do, which is essentially single-person voice recording, it does extremely well and at a very reasonable price. If you have the need for a microphone and an eye for a bargain, the SoloCast should be your first port of call. **–GUY COCKER**

VERDICT

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HyperX SoloCast

⊞ **HAN SOLO** Excellent sound quality; great build quality; USB-C connectivity.

⊟ **GREEDO** Only one recording pattern; no RGB.

$35, www.hyperx.com

SPECIFICATIONS

Polar pattern	Cardioid
Sensitivity	-6dB
Bit-depth	24-bit
Sampling rate	96kHz
Connection type	USB-C
Stand threading	3/8-inch, 5/8-inch
Weight	0.53lb

SteelSeries Arctis Nova Pro

High-fidelity audio in a gaming headset—sounds like a recipe for success

THE NOVA PRO is second in line at the top of the SteelSeries headset hierarchy, below its wireless counterpart. Other than the lack of active noise cancelation and wireless functionality found on the more expensive model, the two have similar specs but there's a $100 price difference. So are these extra features worth that much, or should you opt for the wired variant instead?

You may be wondering why a $250 headset only has wired functionality—but also included in this package is the SteelSeries GameDAC Gen 2 and that's the real game-changer when it comes to other Nova headsets from the brand.

We've previously tested the Nova 7, which is a lesser headset but has decent compatibility. The main difference is that this doesn't come with the DAC, so they appeal to different target markets. The Nova Pro is aimed more at a permanent desktop setting with a focus on audio quality over outright features, whereas the Nova 7 focuses on connectivity and compatibility. The design of the Pro is clearly part of the same lineup as the Nova 7, though both have drifted away from the previous Arctis 7/9 designs from SteelSeries's previous generation.

We loved the previous designs, but the new look takes the style away from a gamer-focused look to a more premium aesthetic. Although we see this as a positive shift in design, the build quality seems to have taken a slight knock in the process. It's not poor, but previous headsets from SteelSeries set the bar almost too high. The new design features an all-black aesthetic with the option to swap out the headband and earcup covers with interchangeable options that are available to buy online. On the Nova Pro, the earcup covers have a metallic effect to emphasize the 'Pro' aspect.

The earcups are covered in a leatherette finish, and feel soft on the head. A volume wheel and retractable microphone are found on the left earcup. This microphone is impressive and features AI-powered ClearCast Gen 2 noise canceling, which worked well at reducing background noise in a busy office. The headband isn't as comfortable as the ski-band style found on the older models, but it's still soft, light on the head and, even after long usage, we didn't feel any pressure points.

As for the GameDAC Gen 2, it feels premium to the touch. It's a weighty device with a minimalist style, featuring a large anodized volume dial, a small 8-bit OLED display, and a back button. The interface allows you to choose between different EQs for the output, select between different inputs, and display what you're listening to. It connects to your PC or other devices via a USB Type-A to Type-C cable, and you can connect up to two devices, with a 3.5mm aux cable connecting the DAC and headset.

The showpiece for this duo is the punchy audio it provides. We initially tested the headset on its own and were impressed by the high level of detail and strong mid-range sound. When we hooked up the DAC, this further amplified not only these characteristics but brought in a whole new level of bass. Without the DAC, this was flatter than we'd have liked but with it, every element of the soundscape was well-delivered and balanced. When gaming with this setup, the DAC elevates the experience to another stratosphere. The audio quality here is nothing short of amazing, but to get an even better sound, we scrolled through the EQs on the DAC and used the Bass Boost setting. This can also be accessed via the SteelSeries engine.

Considering the type of headset this is, having wireless functionality isn't as necessary as on other types of headphones. If you're after outstanding audiophile sound quality for both gaming and music, great comfort, and ease of use, the SteelSeries Arctis Nova Pro goes above and beyond in these aspects. We prefer the older style of headband and build quality but that shouldn't take anything away from this latest design—it is well worth its price tag. –**SAM LEWIS**

VERDICT
9
KICK ASS!

Steelseries Arctis Nova Pro Headset

SUPERNOVA Outstanding audio performance; stylistic design; interchangeable components.

BLACK HOLE No active noise cancelation.

$250, www.steelseries.com

SPECIFICATIONS

Driver type	40mm Neodymium driver
Frequency response	10Hz-40,000Hz
Impedance	38 ohms
Connectivity	3.5mm auxiliary
Compatibility	PC, Mac, PlayStation 4 & 5, Nintendo Switch.
DAC max audio format	96kHz, 24-bit
Design style	Closed back

Razer Basilisk V3 Pro + Mouse Dock Pro Bundle

Is this the peripheral combo your desktop needs?

AS WELL AS the likes of the Naga, Viper, Death Adder, and Orochi, Razer also has the mythical Basilisk in its mouse lineup. The Basilisk V3 Pro sits toward the high end of the Razer mouse range, with the Pro suffix meaning it should have all that was great about the previous Basilisk V3 plus some improved internals and functionality. Starting from a foundation as strong as this, surely that's a recipe for success in itself? But there's more...

This bundle from Razer comes in at just under $200 and contains the Mouse Dock Pro, a wireless charging docking system to keep the Basilisk V3 Pro juiced up. So, for this hefty price, is this Razer duo a worthy addition to your setup?

The Pro model is similar in design to the previous version. It adheres to a more multi-genre-based, all-in-one mouse with more functions than a typical stripped-down esports lightweight mouse. Weighing 0.24lbs, it has a more premium feel to it giving you a smooth steady glide when using it. Style-wise, the Basilisk V3 Pro has an ergonomic shape fitting the curvature of your hand and, just like its predecessor, is far from a symmetrical design. Comfortable would be an understatement and if you intend to be using a mouse for long durations, either for gaming or work, that's an inevitable requirement.

The overall chassis is textured black plastic with rubberized sides for additional grip, which works well over long periods of time. The mouse keeps the same RGB as before, a small but effective amount with an even dispersion. There is a thin strip of under-glow, the Razer logo lights up and the ring around the scroll wheel has a subtle glow.

The scroll wheel is one of the party pieces for the Basilisk V3 Pro. By default, it has a tactile stepped feel. However, press the button just below it and it changes into an extremely smooth free-scrolling wheel. It's incredibly easy to scroll using this method and of course, is swappable on the fly. You thought we were done with the scroll wheel? Not only does it have a button when you press down on it, but you can also click it sideways for extra control, all of which is customizable in the Razer Synapse app.

BUTTONED UP

The mouse has a total of 11 buttons including the ones above and a profile button underneath. Where your thumb rests on the left, there are two side buttons for forward and backward in a web browser and an additional button that is set up as a sensitivity clutch. Press this while aiming your cursor and it will give you much greater control by slowing down the cursor speed, which also works in creative applications too.

Underneath the mouse, there are five PTFE feet to help it glide smoothly across your mouse pad. Here we can also take a look at the wireless capabilities. You'll find a dummy puck at the bottom, twist this to open up the cavity where you can store the mouse's wireless USB receiver. With the Mouse Dock Pro, you get a wireless chagrin puck that you can add to the mouse for wireless charging functionality. The Dock Pro is aesthetically pleasing with a flat, smooth surface where the mouse attaches magnetically, making charging a breeze. You can connect a USB Type-C cable directly to the front of the mouse too if you are taking this thing on the go and leaving the dock behind.

In terms of performance, this mouse doesn't disappoint. With a range of sensitivity options to change on the fly, a maximum sensitivity of 30,000dpi, Razer's HyperSpeed Wireless connectivity, Bluetooth, up to 90 hours battery life, Gen-3 optical mouse switches with a lifespan of 90 million clicks, and a Focus Pro 30K optical sensor, this mouse has plenty of top-end features.

So, then, is this Razer Basilisk V3 Pro bundle worth your time and money? The problem is that it's not a simple yes or no answer. If you're looking for a premium mouse that ticks a lot of boxes, paired with effortless wireless charging capabilities to make your day-to-day life that bit easier, then this mouse covers all of that without a doubt. The issue here is for that price, you expect nothing less. The mouse on its own costs $170, so there is a decent saving to be made by purchasing this mouse and dock bundle. The issue is that the standard Basilisk V3 costs under $70, which makes the Pro variant a bit of a hard sell. –**SAM LEWIS**

VERDICT

8

Razer Basilisk V3 Pro + Mouse Dock Pro Bundle

+ **MYTHICAL BEAST** Abundance of features; great scrollwheel; premium comfort and design; 11 programmable buttons.

− **FAIRY TALE PRICING** Expensive price tag tarnishes the pros.

$200, www.razer.com

SPECIFICATIONS

Sensor	Focus Pro 30K Optical Sensor
Sensitivity	30,000 DPI
Mouse switches	Optical Mouse Switches Gen-3
Battery life	Up to 90 hours (HyperSpeed)
Connectivity	Razer HyperSpeed Wireless, Bluetooth, USB Type-A to USB Type-C
Weight	0.24lbs

Maybe there's a more tactful way to palm off an advance, Jacob?

SURVIVAL HORROR

The Callisto Protocol

Take a walk down some of the moodiest corridors

THE CALLISTO PROTOCOL begins like all good prison films, with a mood of unbearable doom. Workingman pilot Jacob Lee has crash-landed on the dead moon of Callisto after his cargo ship is boarded by a notorious terrorist group. Someone else has died a bizarrely gruesome death during the crash, and we are given plenty of opportunity to study this misfortune. Lee is arrested and it's made clear that he has a life spent in the moon's Black Iron prison to look forward to. But almost immediately, the prison falls foul of some mysterious disaster that turns its inhabitants into crazed mutants.

What better way to set the tone of a relentlessly gory survival horror game than with a disaster, an injustice, and then the abrupt invasion of some walking pus buckets? *The Callisto Protocol* isn't subtle about dropping you into a place of dread. Somewhat counter-intuitively, this dread is strangely comforting to players of this determinedly nasty horror game. The stakes are clear: Lee, played with action-hero stoicism by Josh Duhamel, is in deep do-do and must dig himself out of it. Perhaps we'll learn a bit about that terrorist group. Inevitably, some subplots will creep in, and we'll meet some characters who keep us company. *The Callisto Protocol* wastes no time cementing the terror of its setting. Now, we just need to walk in a straight line for 15 hours and butcher our way through it.

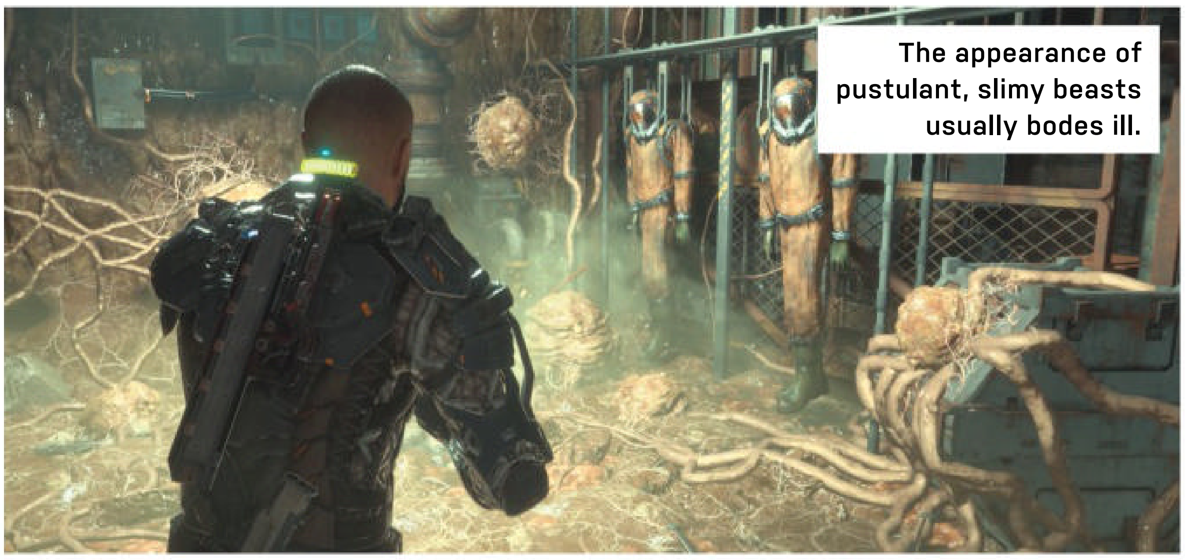
We're not joking when we say that *The Callisto Protocol* is a comforting videogame, albeit on the far end of the same axis occupied by, say, *Dragon Quest*. Familiarity is the comforting factor, and *The Callisto Protocol* is a consistent big-budget joyride. The indie horror scene has potent psychological discomfort covered (see *Visage*, *Signalis*), and is also the natural home of grindhouse schlock (see *Murder House* and countless PS1-era throwbacks). The big-budget horror game, in the *Resident Evil* sense, or most saliently in the *Dead Space* sense, is about roaming moody corridors and regularly getting the life frightened out of you.

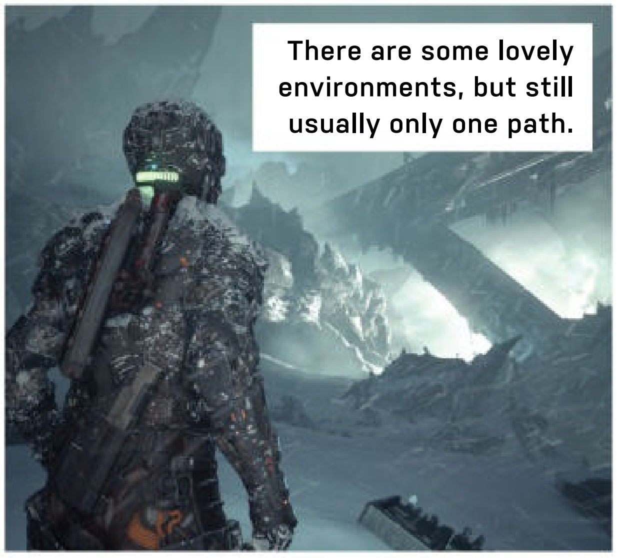
And, boy, does *The Callisto Protocol* have creepy corridors. The opening hours have all the usual varieties covered: claustrophobic engine rooms with burst valves gushing, access halls, maintenance rooms, aged steel, echoing vents, flickering holographic terminals, and subterranean crawl spaces full of pustulent slimy growth. The middle and late hours have a lot of that stuff, though some areas sprawl a little too much, and by the game's end, there are some surprising deviations from the 'grim dark corridor' format. Is this *Dead Space 4*? Or the *Dead Space 3* that many think should have been? Pretty much both.

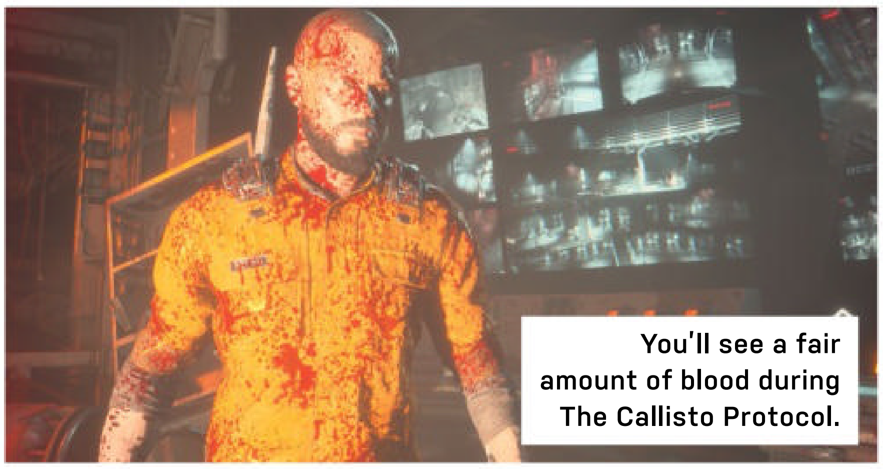
These environments are the most obvious source of that weird comforting sense because, in its opening hours, the feeling when playing *The Callisto Protocol* is very much like that of *Dead Space*. There's the same pristine user interface, the same lumbering, over-the-shoulder control of an emphatically beefy man, and the same freedom to foot-stomp corpses into pools of masticated pudding.

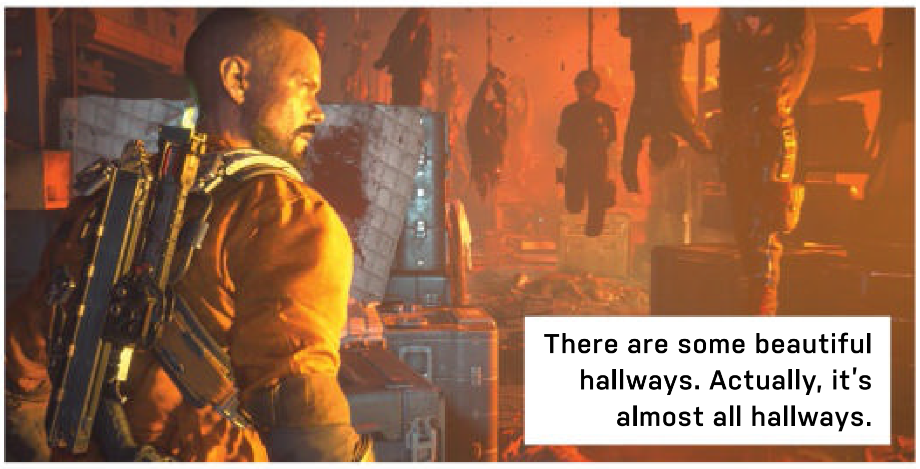
The director of *The Callisto Protocol* is Glen Schofield, who also directed the first *Dead Space*, and he has recreated that game's fine balance of 'powerful and yet vulnerable'.

© KRAFTON


The appearance of pustulant, slimy beasts usually bodes ill.


There are some lovely environments, but still usually only one path.


You'll see a fair amount of blood during The Callisto Protocol.


There are some beautiful hallways. Actually, it's almost all hallways.

We can't fault Schofield for returning to a tried and tested formula. We are fond of the way Lee has the turning circle of a kid's toy tractor, and that no matter how feeble an enemy appears you will absolutely not succeed in melee stun locking them, forcing you to use the somewhat unwieldy left and right dodge system. Why doesn't Lee go full-pelt beast mode like his foes? Why does he move with the burly grace of a slow-mo televised fast bowler? Why does he keep putting his baton away, and why does he retrieve it so slowly? Because this is a horror videogame and so for no better reason than that.

Lee has a glowing green bar on the back of his head that shows his health, and a blue one that indicates whether his 'GRP' has overheated. The GRP is *The Callisto Protocol*'s answer to *Control*'s levitate or *Half-Life 2*'s gravity gun, and it's great fun. In a game full of spongy baddies, this weapon lets you pick most of them up and toss them off platforms and into chasms, or more frequently, into wall-mounted spikes—the moon colony has an alarming amount of these. Or, you can pick up nearby explosives and toss them at your foes, which is less fun, but more sensible because picking up objects uses less energy than levitating mutants.

GRP energy is finite, but like the ammo reserves for *Callisto*'s five ranged weapons (all standard fare, with hard-hitting upgrade paths), we never found ourselves desperately wanting for resources on medium difficulty. You can turn to selling ammunition and occasionally health to level up your abilities at the regular 3D printer workstations. Once you realize how useful the GRP is, you may want to focus on that, though you may eventually decide to invest more into the regular weapons, as the GRP is useless during some of the more torturous late-game fights. You won't fill all upgrade paths in a single playthrough though, so it's worth investing early in your preferred method of death-doling.

Mutants can be carved up limb-by-limb, less as a matter of tactical precision than as a way to keep the carnage fresh, and your GRP can become so powerful that simply throwing them—not even at spikes—will make those limbs go flying. You may not find any of the warted, veined, saliva-abundant baddies especially scary if you have played a lot of horror games with enemies just like these, but there are a few loathsome predators that were the exception. It's not the appearance of these more fearsome mutants that's threatening, but how they move around the environments. There's also the ever-lingering threat that if you don't shoot the emerging tentacles off a mutant they will morph into something more formidable.

This is a rollercoaster of a game and riddled with cinematic videogame clichés—you will navigate a crumbling structure that starts to collapse as you cross it. You'll need to power on a generator by finding three breakers that are located in dangerous locations. You'll need to survive a certain amount of time locked in a claustrophobic space as baddies attack you. And naturally, there is more to what's going on than the narrative précis provided above suggests. In many ways, *The Callisto Protocol* feels like a new, albeit well-qualified studio, singing to the crowd: "We can make the kind of games we know you really want." And we, the crowd—most of us anyway—will sing back: "Yes, you can, keep on going."

A big part of us wants a blockbuster horror game to go off the rails a bit, in a way a lot of people hoped Hideo Kojima would with *Silent Hills*. But it's hard to fault *The Callisto Protocol* for nailing (or GRPing to a row of wall-mounted spikes) exactly what it sets out to achieve—engaging, linear sci-fi survival horror that spins a deepening dystopian yarn around dozens of stressful encounters. In other words, for the abundant masochists among us: comfort food for weirdos, or *Wario Dragon Quest*. –**SHAUN PRESCOTT**

VERDICT
8

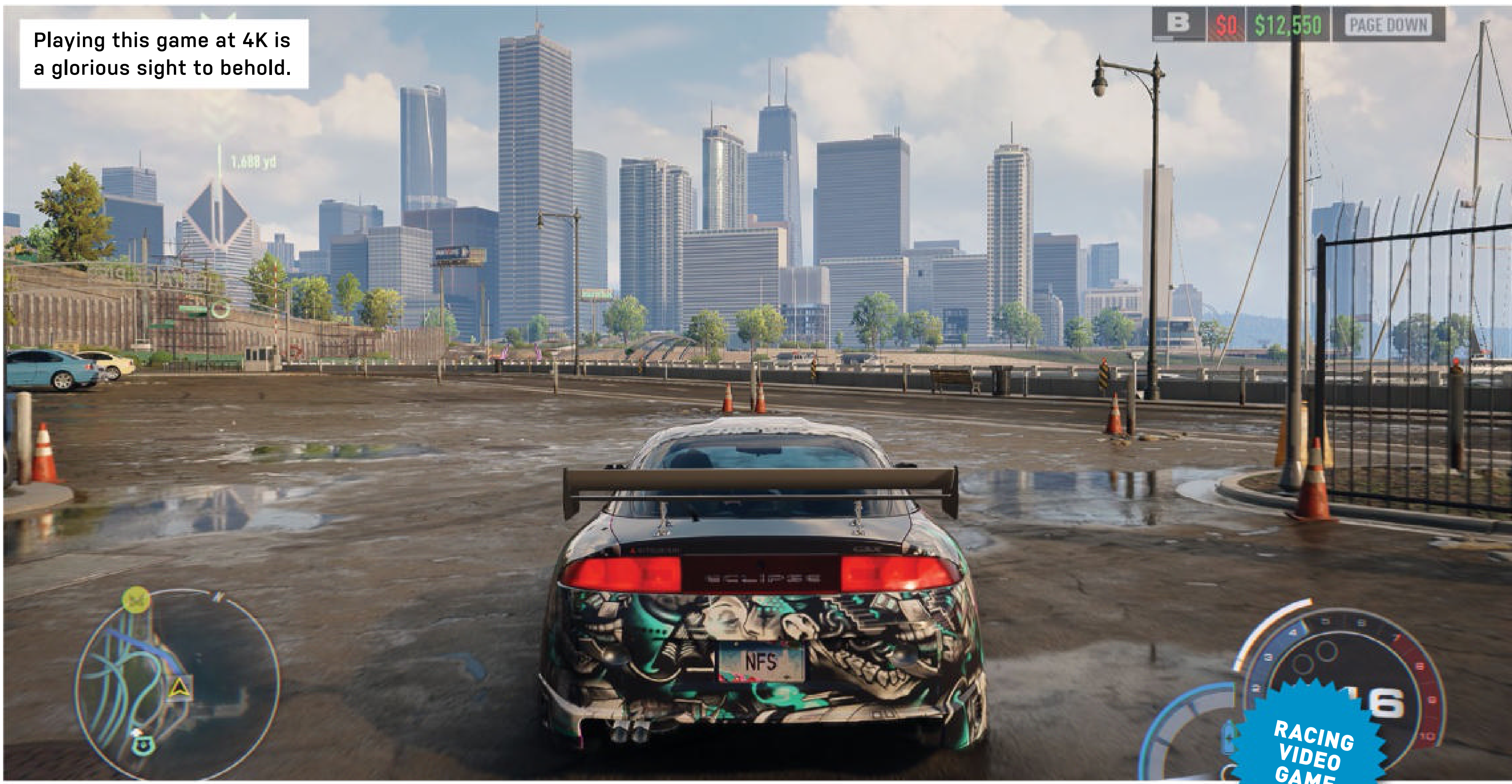
The Callisto Protocol

⊞ **DEAD SPACE** Atmospheric; beautiful; creatively fun weapons.

⊟ **SPACED OUT** Repetitive corridors; unimaginative enemies; structurally nothing new.

RECOMMENDED SPECS CPU, i7-8700 / Ryzen 5 3600. RAM, 16GB. GPU, GTX 1070 / RX 5700.

$60, https://callisto.sds.com/, M-rated



Playing this game at 4K is a glorious sight to behold.

RACING VIDEO GAME

Need for Speed Unbound

The venerable racer returns in zoomer regalia

THERE WAS a time when *Need For Speed* was a guaranteed chart-topper. Before there was *Forza Horizon*, all festivals and physics, there was this. A *Fast and Furious* analog with spoilers on its spoilers, every year exactly the same super-accessible arcade racer about underground tuner culture and corrupt cops. And we didn't care that it became as formulaic as that other long-running bestseller, *Call of Duty*. Until one day, finally, we did.

Need For Speed grew too big and popular to sustain itself. The sales were too good for EA to start tinkering with the formula, but the yearly releases oversaturated us with cars in widebody kits and stories of betrayal told exclusively through the medium of checkpoint races. The world that *Need For Speed Unbound* emerges into has changed. *NFS Heat* in 2019 was the franchise's most convincing attempt at reinvention, but it couldn't nudge *Forza Horizon* off its throne. *Need For Speed Unbound* needs to be something totally distinct to succeed.

Enter the new art style. This is an old franchise stepping out in its finest zoomer haircut and puffer jacket, hoping to find traction with the TikTok generation through a dramatic change of visual direction. It might seem like an incidental touch, but the anime-inspired smoke plumes and metaverse-ready avatars in *Unbound* are a statement of intent for such an established series. When you drift around a corner and light up your tires a cartoon miasma appears. Painterly neon lines whizz around in circles beside your tires during a burnout and your car sprouts a pair of graffiti wings when you hit a ramp. This from a game that's stuck to the same plot about double-crossing street racers and psychopathic law enforcement officials for two decades.

For the first time, *Need For Speed* looks the way it drives. It doesn't entirely wave goodbye to reality but exaggerates and augments it. This isn't how your car would behave if you flung it into a 90-degree turn at 120mph with a dab of the brakes, these are cars as you want them to behave. Cartoonishly compliant, twitchy things that don't make use of a sim racer's skills any more than a 4X player's.

Unbound's tonal shift finds cohesion between its presentation and its gameplay, but the handling itself doesn't sing to you like a siren's call dragging you away from *Forza*. It's hard enough to get your head around the fact that you essentially brake by tapping the throttle, but it's not the laissez-faire physics model that fails to inspire. Instead, *Unbound* often feels as though you're cycling through micro-animations without much granular control. When you enter a drift, there's no sense of your vehicle's weight being thrown from one side to another, or the subsequent loss of traction on the loaded side as your tires reach their grip limit. It feels like the game has recognized inputs that initiate a drift.

Most of the time, it's enjoyable enough. It serves the style of racing *Unbound* offers: light on the corners and braking zones, focusing more on hitting top speed and holding it for as long as possible while snaking through busy urban tarmac. But when you're in a tight race and a low-speed corner appears, you want to be able to edge ahead due to your superior control of the vehicle. And Criterion's handling model just doesn't offer that.

Not that there isn't skill in going fast. The margins between decent and good driving are all about boost generation and management. A slightly confusing double-layered NOS boost system fills up as you do dangerous stuff—driving into oncoming traffic, near misses with vehicles, or drifts—and offers additional shots of boost for chaining these feats. If you game this mechanic hard, you can

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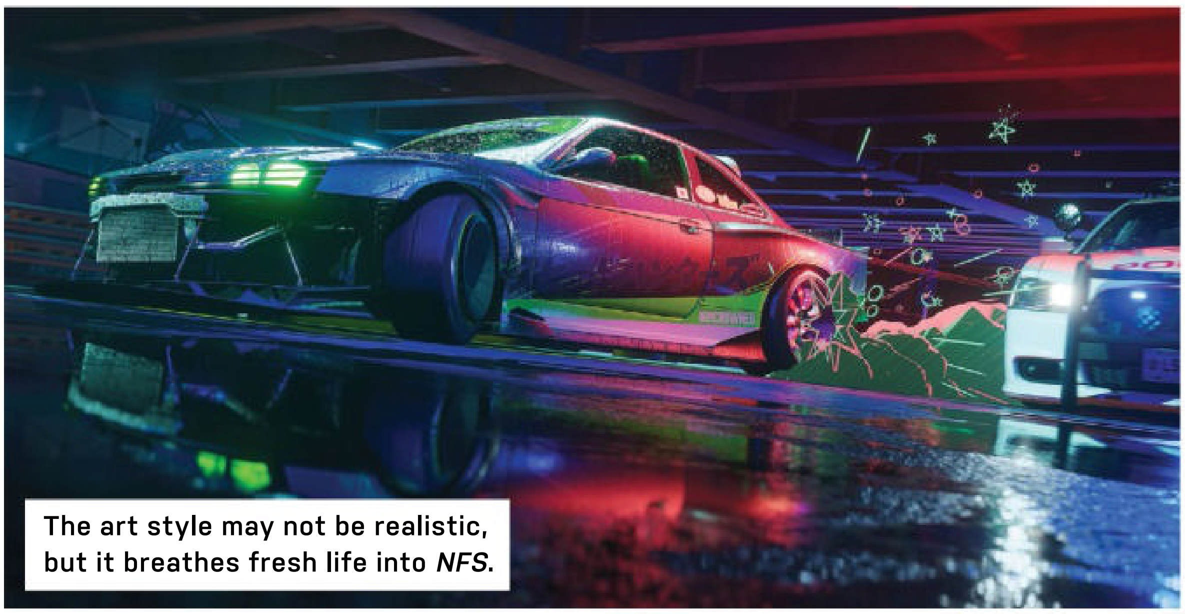
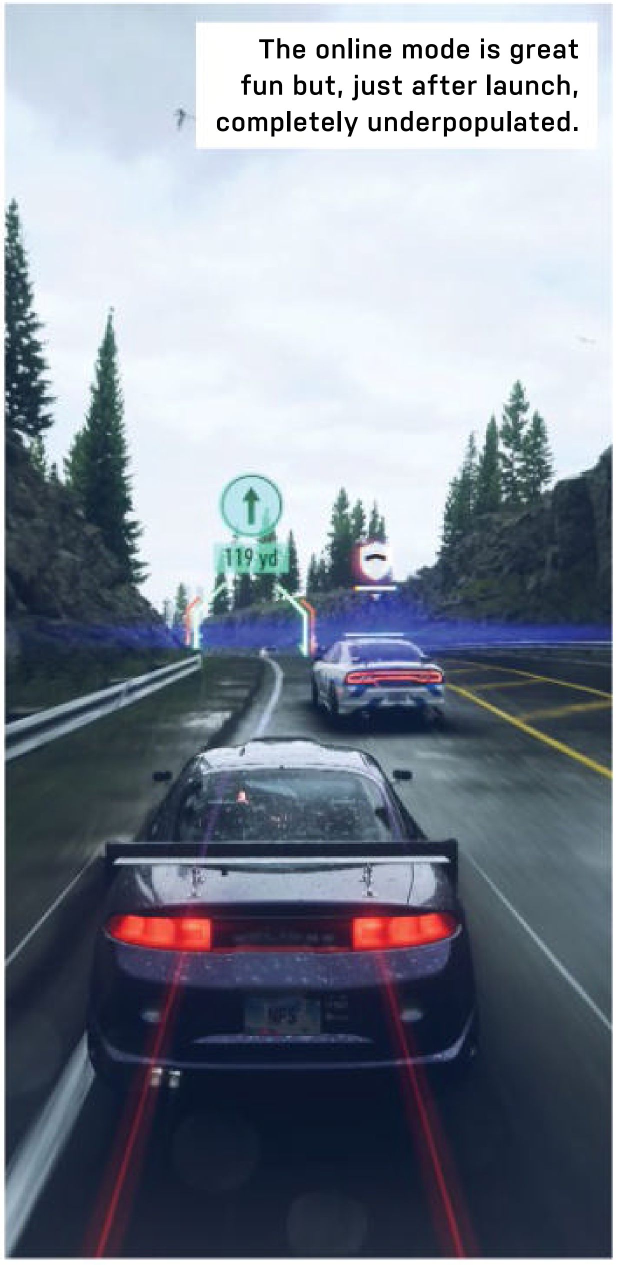
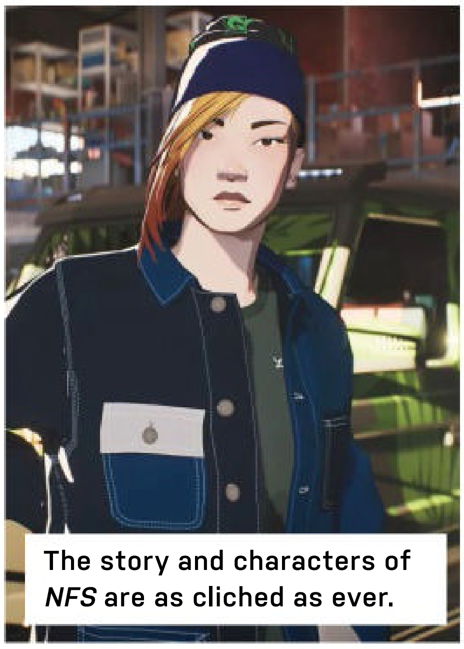
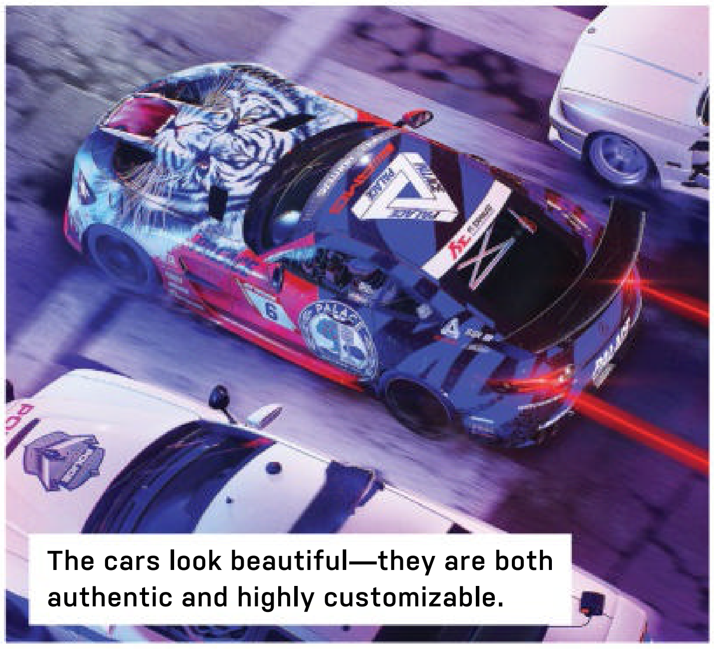

The art style may not be realistic, but it breathes fresh life into *NFS*.


The online mode is great fun but, just after launch, completely underpopulated.


The story and characters of *NFS* are as cliched as ever.


The cars look beautiful—they are both authentic and highly customizable.

be boosting for half the race or more, and that makes a big difference to your times. It's just a different discipline than many racers ask of you.

What's likely to get you far more invested is the returning heat system. In the last *NFS*, this introduced a bit of risk-reward via the day/night cycle: all the cash you earned during the day would be in jeopardy if you were caught up to no good at night and got busted. That same system's intact here, but the day/night cycle has been expanded to a full working week of events, with showcase races each Saturday with massive buy-ins and vehicular prizes.

What it's lost since the last game is the heat multiplier, which encouraged you to annoy the cops in order to raise your heat level before the end of the night. With a x5 heat multiplier on your rep, you'd bank huge XP and unlock new cars and parts that were previously out of reach. That's gone, and it feels like a step backward. If anything, we wanted to see the next *NFS* game double down on Heat by introducing something like *Shadow of Mordor*'s nemesis system to racing games—cops you form vendettas with, take them down for huge bonuses, get busted and lose a car. That type of thing.

What there is in place of that excellent idea is a rather more straightforward daily routine where you tick off as many events as possible before your rep level makes the game too annoying to play and you call it a night to reset your heat and bank your cash. The cops here are as dogged as ever, more than willing to risk their lives—and those of absolutely anybody else in the vicinity—to apprehend a driver who flouts the speed limit. And once again, it's not even clear how the chase AI really works: is it better to hit max speed and hold it until they lose touch, or keep taking turns? It's been 20-plus years and we still don't know.

It might be straining to appeal to the youth, but *NFS Unbound* is still a loose and colorful racer, capable of whipping you up into its nonsensical plot and getting you to obsess over your next car for its duration. Beyond that, there is an online multiplayer mode, but it's already ghostly quiet despite the EA Access program offering 10-hour free trials. There's nothing wrong with it—playlists of events from single-player, accessible in PvP races of up to eight, generous cash rewards—it's just that nobody's playing. *NFS* has always struggled and *Unbound* doesn't appear to be a turning point.

Nor is it quite the return to glory and prominence that *Need For Speed* once enjoyed. It's more feature-rich and mechanically complex than all of its predecessors—it's just that its rivals are a lot better than they were circa 2007. The distinctive new look is a great success, and although the handling has some quirks it's engrossing to figure out the boost system and max its potential. A braver Criterion and EA might have made more of the heat system, finding a new identity in that brilliant risk-reward mechanic. But even though it doesn't go as far as it could have, *Unbound* is a deeply worthy addition to a genre that lacks all-out arcade kicks. **–PHIL IWANIUK**

VERDICT 7

Need for Speed Unbound

➕ **UNBOUND:** Great art style; fun racing; enjoyable multiplayer mode.

➖ **REBOUND** Same old cliched story; overenthusiastic obsession with 'the youth'; multiplayer is underpopulated.

RECOMMENDED SPECS CPU, Core i7-8700 / Ryzen 5 3600. RAM, 16GB. GPU, RTX 2070 / RX 5700.

$70, www.ea.com/games/ T-rated

LETTERS

WE TACKLE TOUGH READER QUESTIONS ON...

> Windows Adverts
> Costly 'Budget' Builds
> Storage Solutions

Windows Thin Edge of the Wedge

I am getting concerned about the number of adverts I'm seeing on Windows these days. It feels like the 'thin end of the wedge' principle happening in real-time—one small change, if not opposed, can lead to greater changes later on.

For example, those 'offers' from Microsoft in the Start menu seem innocuous enough, and closing them is easy. But why would Microsoft stop placing them? It can hardly cost Microsoft any money to put them there, so any orders they get from the ad count as pure profit.

At this point, the wedge remains thin. But it'll start to get thicker once people get used to the ads, encouraging Microsoft to go and sell the space to other companies. At first, this might be a 'suggested' offer from Amazon or Norton. The grumbles on Twitter will continue, but enough people will click the links to spur Microsoft to thicken the wedge even more by showing flashing ads from every Tom, Dick, and McDonald's.

I'll then realize a few weeks later, as I see Jamie Foxx's face on my lock screen telling me to get a new Intel laptop, that the wedge has finally gotten too thick. Once Microsoft opens a Pandora's Box of advertising, it will be impossible to close.

–D. Reardon

EDITOR-IN-CHIEF, GUY COCKER, RESPONDS: Mr. Reardon is probably right that adverts in Windows are only going to get more prominent and appear across more sections of the operating system. Having seen the way these things go in the past, Microsoft will inevitably go too far—maybe with adverts being plastered on the lock screen as he suggests—and be forced to backtrack.

Microsoft is currently testing different types of adverts to see which hit the 'sweet spot' of being regularly clicked without causing too much anger. If you're already fed up with these intrusions, you can turn them off in your personalization settings. We will have a tutorial on how to block ads in Windows in the next issue.

Fake SSD Warning

I wanted to write to you to make your readers aware of the amount of fake SSDs being sold on online retailers like Amazon and eBay. Experienced buyers should be able to spot a fraud by looking at the price—how can a 16TB SSD be sold for around $100, when a genuine 500GB microSD card costs around $50?

The internet is awash with these fake devices. Amazon and eBay should be doing more to stop them. I suppose they will only do so when loads of people start buying them, then return them and demand their money back, which is when it will become a problem for them.

–M. Albin

EDITOR-IN-CHIEF, GUY COCKER, RESPONDS: Yes, there is a problem here, and you're right in saying retailers should be doing more to protect buyers. A quick search on Amazon's site for '16TB SSD' brings up a list of many dodgy companies all paying for sponsored slots on Amazon's search, meaning they are the first devices anyone will see. They're all available for $100 or under from companies we've never heard of, including Wiota, DFILL, and even the hilarious 'Generic'. What won't be hilarious is if you end up buying one and finding it either doesn't work, isn't the capacity it suggests, or gives up the ghost without a warranty. We did find one genuine 16TB SSD device—iStorage's diskAshur2. The price... $4,614. You really do have to pay that much for storage of that size.

Not such a bargain

In your *Blueprints* section of the mag, I take umbrage with your 'budget' builds. I know the price of CPUs and GPUs pushed the high-end prices sky-high, but you have run $300, $500, and $1,000 builds many times—those are budget builds. Until recently, $1,200 was the mid-grade build in *Maximum PC*. Because of where the high end is, you may need to go to four tiers, scrap the budget blueprint, or do something else, if you are page limited. Calling an Intel i5-12600K-based system a 'budget build' is a serious misnomer. **–R. Matlow**

↘ submit your questions to: editor@maximumpc.com

EDITOR-IN-CHIEF, GUY COCKER, RESPONDS: Thanks to regular letters page contributor R. Matlow for their comment, which I am sure many people will agree with. Of course, it's a fair point that a budget build should not exceed $1,000, especially in these expensive times. But, to back Sam up on this (who manages the *Blueprints* section each issue), it's only the Intel build which has gone past $1K in the last few months, and he's been upfront with his rationale for spending more on that build! The AMD build, meanwhile, was priced at $954 last issue.

We're also at the start of a new generation of AMD and Intel processors and AMD and Nvidia GPUs. As we cover in the news this issue, more lower-end/higher-value graphics cards will be arriving shortly, as well as cheaper CPUs. If those products are any good, we'll update the budget build accordingly.

One thought that this letter has prompted, though, is that I've always assumed that a budget build should be able to offer 1080p gaming, but perhaps that's not the case. I'd love to hear from readers whether that's something you care about from a budget build. Of course, dropping the GPUs or going even more low-end would lower the costs of our cheaper builds. Let me know what you think!

Stay Cool

The 8K Gaming Monster in the Holiday 2022 issue of *Maximum PC* is built with the AIO CPU cooler on the front of the case and exhaust fans on the top. This, of course, brings outside cool air directly in contact with the cooling fins of the AIO but also results in heated air being blown into the case.

An alternative construction would be to place the AIO on the top of the case and normal intake fans at the front. This would introduce outside cool air directly into the case but would mean the air flowing across the AIO's cooling fins was a mixture of the cool incoming air and the heated air rising from the motherboard, GPU, and other components.

It seems there could be some interesting tradeoffs between the two approaches (eg. a cooler CPU vs. a hotter GPU or vice versa) and it isn't clear to me which is the better approach. Have you ever performed a comparison test to determine which approach is the better one? On the other hand, if I've overlooked the obvious and the verdict is clear, please enlighten me. **–S. Mazzone**

The Asus ROG Maximus Z790 is expensive, but has storage options galore.

EDITOR-IN-CHIEF, GUY COCKER, RESPONDS: When it comes to mounting an AIO cooler, there are pros and cons to both front and top positions. It's not worth worrying about too much and often comes down to where it fits best—if it's a 360mm radiator and you have a small case, it probably has to go up front.

I put together the build mentioned in your letter, and, as I said in Step 7 of the feature, if I was doing it again, I probably would have mounted the NZXT Kraken X73 RGB in the top rather than the front, because it would have allowed me to use more of my available RGB fans. This would have produced a slightly cooler-looking build (depending on your love of RGB, of course!). But it's not something I'd spend much time worrying about, to be honest.

It's probably worth a scientific A/B test though, with temperature readings, benchmarks, and long-term testing to try and definitively answer this question. We're in a fantastic period for new PC tech at the moment though, with loads of exciting new products and trends to talk about, so once things have settled down, it's something we'll look at. In the meantime, if you want the best cooling solution, Sam is planning another water-cooled build shortly!

PCIe Performance

What a fantastic Holiday 2022 issue—I've been looking to build something similar to your monster machine, and this magazine came out right in time.

I was particularly impressed that you wrapped the overall build with thoughtful, directly related articles on key questions such as DDR4 vs. DDR5 and Z760 vs. Z790. You foreshadowed this in earlier issues, and glad you brought it home in this one. It's helpful for those building systems in constrained times to understand what real-world gains come with buying the shiniest of new offerings.

But I have a question: it wasn't too many years ago where PC builders planned out their drives based on where the OS, Windows partition, applications, and data all lived, and I'm specifically focused on performance, ie, CPU vs. motherboard vs. PCIe lanes and data-bus access, not storage capacity.

Does this not matter anymore? Can I just hang everything off of the Asus ROG Maximus Z790 with 5 M2 drives and expect everything to be equal?

–T. Hammell

EDITOR-IN-CHIEF, GUY COCKER, RESPONDS: Thanks for the compliments and I'm glad you enjoyed the monster build. I wish I could say it was as fun to build as it was for you to read because I had no end of problems getting that system running! The end results and gaming performance made all the pain worthwhile, though.

The move to high-performance and relatively high-capacity M.2 SSDs has changed the way that we manage storage these days, to the point where I imagine many *Maximum PC* readers have long since moved on from SATA drives. We still include them in our blueprints, and I have an HDD for all my Steam games, but if I had to, I could lose it (please don't make me, though!).

If you're lucky enough to be able to afford the Asus ROG Maximus Z790 mobo, then all of the three M.2 slots operate at PCIe 4.0 speeds, plus there's an expansion card for future PCIe 5.0 compatibility if you're buying a new drive.

And with six SATA ports as well, it's not something to be overly concerned about. But do follow up if you have any specific questions about data management across drives and I will pass your query to our in-house Doctor.

THE BUILDS

THIS MONTH'S STREET PRICES...

AS PERIPHERALS and components come out with new variants and generations all the time, prices naturally creep up—something that has certainly sneaked up on us all within the tech industry. After a recent review of this section, we noticed the prices of our budget builds had increased, so we've reeled things back, re-evaluated these machines and got them into a more realistic 'budget' level. That may mean the builds taking a hit in performance, but hopefully nothing too drastic.

The first change is to swap out our Intel Core i5-12600K for a more affordable 12th-gen chip that still has integrated graphics, so we've gone for the Intel Core i3-12100. This chip has a max turbo frequency of 4.30GHz, four performance cores, and eight threads. It's a step down from the 12600K, yet this i3-12100 CPU is dependable for a budget machine and saves us at least $100.

We've also swapped out our Z690 board for an ASRock B660M Phantom Gaming 4, which helps reduce costs by around $45. As our processor is no longer a 'K' variant, we can't overclock it so the Z690 would have been wasted. The final change is our RTX 3060 back to an RTX 3050—for a budget build, this is good enough for a 1080p gaming experience. We've chosen Gigabyte GeForce RTX 3050 Eagle OC 8GB, saving a further $60.

There were fewer changes on the AMD budget machine. The first thing we did was to halve our 4TB drive and go for the 2TB Seagate Barracuda Compute 7200 HDD, which we also added to the Intel machine. A 500GB PNY CS2140 PCIe 4.0 SSD was also brought in for both machines, bringing the total cost for storage to $90 each on the AMD and Intel builds. We also swapped out our previous PSU for a similar EVGA model as the latter was out of stock. The main change was to downgrade slightly from an RX 6650XT to an RX 6600XT as the previous GPU we had in from Gigabyte was no longer on sale.

AMD INGREDIENTS

PART			PRICE
Case	Corsair 4000D Airflow		$95
PSU	550W EVGA 700 GD Gold 80+ Gold	**NEW**	$60
Mobo	ASRock X570 Steel Legend ATX AM4	**NEW**	$134
CPU	AMD Ryzen 5 5600X		$160
GPU	ASRock Radeon RX 6600 XT Challenger D OC 8GB	**NEW**	$290
RAM	16GB (2x 8GB) PNY XLR8 Gaming EPIC-X RGB @ 3200MHz		$60
SSD	500GB PNY CS2140 PCIe 4.0 M.2 SSD	**NEW**	$40
HDD	2TB Seagate Barracuda Compute 7200	**NEW**	$50
OS	Windows 10 Home 64-bit OEM (Windows 11 Compatible)		$32
Approximate Price:			**$921**

INTEL INGREDIENTS

PART			PRICE
Case	Corsair 4000D Airflow		$95
PSU	550W Asus ROG Strix 80+ Gold		$70
Mobo	ASRock B660M Phantom Gaming 4 Micro ATX LGA1700	**NEW**	$109
CPU	Intel Core i3-12100	**NEW**	$130
GPU	Gigabyte GeForce RTX 3050 EAGLE OC 8GB	**NEW**	$290
RAM	16GB (2 x 8GB) PNY XLR8 Gaming EPIC-X RGB DDR4 @ 3200MHz	**NEW**	$60
SSD	500GB PNY CS2140 PCIe 4.0 M.2 SSD	**NEW**	$40
HDD	2TB Seagate Barracuda Compute 7200	**NEW**	$58
OS	Windows 10 Home 64-bit OEM (Windows 11 Compatible)		$32
Approximate Price:			**$884**

MID-RANGE

AS WE'VE SHAVED a few dollars off our budget builds, it only seems right to apply the same strategy to our mid-range builds. We made a few changes across both mid-range systems this month—again, with a slight hit to performance to get the systems back to a more appropriate price. GPU prices haven't helped, and as we're choosing to keep up to date by using the latest 13th gen Intel chips and AMD Ryzen 7000 series processors, the rest of the accompanying components aren't currently the cheapest.

Kicking things off with AMD, we've downgraded from an RX 6800XT to an RX 6750XT saving us $350 (the cheapest available 6800XT was $780). The RX 6750XT is still a decent GPU for 1080p and even 1440p gaming, and is perfect for our mid-range build.

Three other changes also made it over to the Intel PC—the PSU, RAM, and HDD. For the latter, we used the 2TB Seagate Barracuda Compute 7200 HDD from the budget machines. That's plenty of storage and, at $50, it's hard to turn down.

When making all the relative changes to the builds, both had estimated wattages of under 550W but, to be sure, we gave both Corsairs RM650 PSU in case of any overclocking and also as a safety net. For the RAM, we chose the same Corsair Vengeance DDR5 sticks as before but opted for the slower speeds of 4800MHz instead of 5200MHz to save a few bucks.

The team Intel machine also saw a change in GPU to the Asus GeForce RTX 3070 Dual V2 OC 8GB from the previous Gigabyte RTX 3070 Ti. Again, this was done to save money while also maintaining reasonable performance. Other changes include changing the SSD to 1TB of Corsair's MP600 PRO NH M.2 and also swapping out the motherboard from the MSI PRO Z690-A ATX to ASRock's Z690 Phantom Gaming 4/D5 ATX to save around $15 in total. That's an overall saving of $127 on the Intel machine and $133 on the AMD build.

AMD INGREDIENTS

PART		PRICE
Case	NZXT H7 Flow	$130
PSU	650W Corsair RM650 80+ Gold **NEW**	$85
Mobo	ASRock B650E PG RIPTIDE WIFI ATX AM5	$230
CPU	AMD Ryzen 7 7700X	$330
Cooler	Cooler Master MASTERLIQUID ML240L RGB V2	$98
GPU	ASRock Radeon RX 6750 XT Phantom Gaming D OC 12GB **NEW**	$430
RAM	32GB (2 x 16GB) Corsair Vengeance DDR5 CL40 @ 4800MHz **NEW**	$120
SSD	1TB Crucial P5 Plus NVME M.2 PCIe 4.0	$94
HDD	2TB Seagate Barracuda Compute 7200 **NEW**	$50
OS	Windows 10 Home 64-bit OEM (Windows 11 Compatible)	$32
Approximate Price:		**$1,599**

INTEL INGREDIENTS

PART		PRICE
Case	NZXT H7 Flow	$130
PSU	650W Corsair RM650 80+ Gold **NEW**	$85
Mobo	ASRock Z690 Phantom Gaming 4/D5 ATX LGA 1700 **NEW**	$175
CPU	Intel Core i5-13600K	$300
Cooler	Cooler Master MASTERLIQUID ML240L RGB V2	$98
GPU	ASUS GeForce RTX 3070 Dual V2 OC 8GB **NEW**	$570
RAM	32GB (2 x 16GB) Corsair Vengeance DDR5 CL40 @ 4800MHz **NEW**	$120
SSD	1TB Corsair MP600 PRO NH M.2 PCIe 4.0 **NEW**	$105
HDD	2TB Seagate Barracuda Compute 7200 **NEW**	$50
OS	Windows 10 Home 64-bit OEM (Windows 11 Compatible)	$32
Approximate Price:		**$1,665**

TURBO

FINALLY, WE HAVE the turbo builds—our top-tier machines with an emphasis on power and style. We considered cutting the costs here too, however, our turbo machines are designed to showcase the latest and greatest peripherals, but we'll obviously still try and shave a few bucks off where we can.

Starting with the AMD turbo build, it's about time to add a new next-gen GPU into the mix. We opted for the Radeon RX 7900XT card instead of the top-end Radeon RX 7900XTX. It's slightly down on power compared with its sibling and compared with the GPU on the Intel side, but this 7900XT comes with 20GB of GDDR6, DisplayPort 2.1 connectivity, a boost clock of 2560 MHz, and AMD's RDNA 3 Architecture for reliable 4K gaming.

We specifically chose the XFX Speedster MERC 310 Black Edition card as we could pick it up for under $1,000. On the other hand, the RX 7900XTX was way over its RRP—at the time of writing, the cheapest one we could find was around $1,500, which is a heavy premium for that card. GPU aside, the build remains the same, as we'd already brought in the AMD Ryzen 9 7900X AM5 chip and accompanying components previously.

We also had a change in GPU with the Intel turbo build, albeit just in terms of brand rather than the processor model itself. Out went the Zotac Gaming Trinity OC GeForce RTX 4090 24GB and in came the Asus TUF Gaming OC GeForce RTX 4090 24 GB. This was purely based on cost, as the Zotac card had crept over the $2,000 mark, sending shivers down our spine.

The price of the Asus variant didn't exactly have us singing and dancing either, but it's $200 cheaper for virtually the same performance (which we must add, is nothing short of phenomenal). GPU aside, we brought in the ASRock Z790 PG Lightning DDR5 ATX motherboard to replace the Gigabyte Z790 Aorus Elite AX DDR5 ATX, saving around $40 in total. Other than that, nothing else changed on either of the turbo builds, and we're very pleased with where they stand right now.

AMD INGREDIENTS

PART		PRICE
Case	Phanteks Enthoo Pro 2 Tempered Glass	$190
PSU	1000W Corsair RM1000 80+ Gold	$168
Mobo	ASRock X670E PG Lightning ATX AM5	$260
CPU	AMD Ryzen 9 7900X	$440
Cooler	Cooler Master MasterLiquid ML360R RGB 66.7 CFM 360mm	$145
GPU	XFX Speedster MERC 310 Black Edition Radeon RX 7900 XT 20GB **NEW**	$980
RAM	64GB (2x 32GB) Corsair Vengeance DDR5 CL40 @ 5200MHz	$250
SSD	1TB WD Black SN850X M.2 PCIe 4.0	$100
HDD	6TB WD Blue 5400 HDD	$80
OS	Windows 10 Home 64-bit OEM (Windows 11 Compatible)	$32
Approximate Price:		**$2,645**

INTEL INGREDIENTS

PART		PRICE
Case	Phanteks Enthoo Pro 2 Tempered Glass	$190
PSU	1000W Corsair RM1000 80+ Gold	$168
Mobo	ASRock Z790 PG Lightning DDR5 LGA 1700 **NEW**	$210
CPU	Intel Core i9-13900K	$600
Cooler	NZXT Kraken X73 73.11 CFM 360mm	$185
GPU	ASUS GeForce RTX 4090 TUF GAMING OC 24GB **NEW**	$1,800
RAM	64GB (2x 32GB) Corsair Vengeance DDR5 CL40 @ 5200MHz	$250
SSD	1TB WD Black SN850X M.2 PCIe 4.0	$120
HDD	6TB WD Blue 5400 HDD	$80
OS	Windows 10 Home 64-bit OEM (Windows 11 Compatible)	$32
Approximate Price:		**$3,635**

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PAPER POWER

More than half of the energy demand at U.S. pulp, paper and paper-based packaging mills is met using renewable, carbon-neutral biomass energy.

Source: American Forest & Paper Association, 2022

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